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A SUMMARY OF INDIAN CHEILANTHOID FERNS AND THE DISCOVERY OF *NEGRIPTERIS* (PTERIDACEAE), AN AFRO-ARABIAN FERN GENUS NEW TO INDIA

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Key words: *Cheilanthes*, *Aleuritopteris*, *Notholaena*, *Negripteris*, fern, Rajasthan, India

ABSTRACT

A summary of Indian cheilanthoid ferns treated under nine genera includes three new names, *Notholaena dipinnata* Fras.-Jenk., *Cheilanthes bhutanica* Fras.-Jenk. & Wangdi and *Cheilanthes tibetica* Fras.-Jenk. & Wangdi, and five new combinations, *Cheilanthes nitidula* Hook. subsp. *henryi* (Christ) Fras.-Jenk., *Aleuritopteris bicolor* (Roxb.) Fras.-Jenk. & Dulawat, *Aleuritopteris subdimorpha* (C.B.Clarke & Baker) Fras.-Jenk. and *Notholaena muelleri* (Hook.) Fras.-Jenk. *Negripteris scioana* (Chiov.) Pic.Serm. (*Pteridaceae*), a close relative of both *Aleuritopteris* and *Chrysochosma*, was discovered by the second author in semi-arid conditions in the Kumbhalgarh and Sitamata Reserves of the Aravalli Hills in central Rajasthan, N.W. India, the first record for the Indian sub-continent. It was known previously only from N.E. Africa, Socotra and S. Arabia and is an Afro-Arabian species which, as now found, extends eastwards into the hills of the semi-arid region of W. India.

INTRODUCTION

The cheilanthoid ferns of India have at various times been placed in the families *Sinopteridaceae*, *Negripteridaceae*, *Cheilanthaceae* and *Hemionitidaceae*, but are now generally accepted as belonging to subfamily *Cheilanthoideae*, within *Pteridaceae*, with the other four families, among others, in its synonymy. The common term cheilanthoid is a vague and undefined one, though it should be recognisable to most fern-workers. The most obviously "cheilanthoid" ferns of India belong to nine genera, though various other genera are also allied or within Subfam. *Cheilanthoideae*, but are not dealt with here (see, for example, Tryon, Tryon & Kramer 1990). These nine genera with their Indian subcontinental species are as follows:

1. *Notholaena* R.Br., includes *Cosentinia* Tod., *Paraceterach* Copel. and *Paragymnopteris* K.H.Shing, perhaps also *Chrysochosma* (J.Sm.) Kümmerle. This genus has long been accepted internationally as typified by *N. marantae* (L.) Desv., following Christensen (1905) and subsequently the carefully reasoned work of Pichi Sermolli (1981, 1989). An apparent lectotypification by Smith (1875) merely used the word "type" in the sense of "typical species", or even "representative species" and in several other cases Smith cited species not included by the original author of a genus, or even cited more than one species after the word "type". His misuse of the word

"type" is therefore not acceptable as effective lectotypification. Christensen's proper lectotypification was also followed world-wide, including in N. America (Tryon 1956, 1964 *et al.*), but Tryon & Tryon (1980) subsequently reversed it in favour of his own local regional misapplication of the name *Notholaena* to the N. and C. American segregate-genus, *Chrysochosma* (J.Sm.) Kümmerle, on the basis that Smith's "lectotypification" was earlier, though that was then rejected by the International Committee for Nomenclature (Pichi Sermolli 1981), which Tryon did not mention again. He thus ignored the bulk of literature across four other continents of the Old World, which created considerable nomenclatural confusion, and was subsequently supported locally in the USA by Yatskievych & Smith (2003). The conservation of *Notholaena* with a conserved type, *N. marantae*, is therefore advisable to restore the *status quo ante* without any room for doubt and allow current Old World authors to continue using *Notholaena* in its usual sense. Neither the Australian genus *Paraceterach*, nor Shing's genus, *Paragymnopteris*, are accepted as replacing *Notholanea* for the eight well marked Old World species. *Notholaena*, in its traditional and present sense, and *Chrysochosma* are very close, critical genera, very difficult to define separately, and maintained largely on molecular grounds of unknown and possibly minor taxonomic significance. Their separability at a rank as high as genus is somewhat doubtful, despite being accepted in the USA, but if maintained, Pichi Sermolli (1989) has already made the great majority of necessary combinations for the New World species within *Chrysochosma*. *Notholaena* species are frequently exindusiate (without a pseudoindusium) and usually markedly hairy/scaly on the surfaces and axes; they often have the sori spreading down the veins from the margin, as a derivative from the marginal condition in many other cheilanthoid ferns. The five Indian subcontinental species are:

N. himalaica Fras.-Jenk. (1997) (syn.: *Gymnopteris vestita* (Hook.) Underw., shown to have been misplaced in that genus by Mickel (1974)). Simply pinnate, with slightly elongated-ovate, densely silky-hairy pinnae. Widespread throughout the W. and E. Indo-Himalayan region, except for the far west Himalaya; Tibet; and S.W. China.

N. borealisinensis (Kitag.) Fras.-Jenk. (1997) (probable syn.: *Gymnopteris bipinnata* var. *auriculata* (Franch.) Ching). China; newly reported from the Indian subcontinent in Bhutan (Thimphu, Taba, *CRFJ* 31573, 11 Oct. 2005, TAIF). Simply pinnate; distinguishable from *N. himalaica* by its smaller, cordate-based pinnae, narrowing slightly more to their apices and thus hastate-sagitate in shape.

Notholaena dipinnata Fras.-Jenk., ***nom. nov.*** for *Gymnopteris bipinnata* Christ, Not. Syst. (Lecomte) 1: 55 (1909), *non N. bipinnata* Liebm. The lower pinnae are again pinnate and the upper ones lobed. The relationship between this species and *N. borealisinensis* is unclear as some intermediate plants appear to connect them together, though not in the Indian subcontinent. They were therefore treated as two varieties by Ching, but it is not considered likely here that the two extremes could merely represent variation within a single species. The intermediates require further study. This species has not been found in India, as the record by Fraser-Jenkins (2008), from Arunachal Pradesh (Lohit. *B. Krishna* 48966, ASSAM) was in error for a scrumpled specimen of *N. borealisinensis*, but it is mentioned here to explain its separation from the previous species and because it occurs very near to the border in S.W. China.

N. marantae (L.) Desv. Sometimes stated to consist of three subspecies in Europe and Macaronesia, subsp. *marantae*, subsp. *subcordata* (Cav.) Benl & Poelt and subsp. *cupripaleacea* (Benl) Rivas Mart. *et al.*, but these merely represent minor variation

within the species and are not considered here to be appropriately ranked as subspecies, or needing recognition. Cape Verdes; Morocco; Algeria; Ethiopia; Macaronesia; across S. Europe; the Caucasus and Turkey; Cyprus; Lebanon; Syria; Iran; Yemen; from the west to east Indo-Himalaya; Tibet; and S.W. China. *N. marantae* is diploid sexual, with $n = 29$, including from Uttarakhand, and a report by Khullar, Sharma & Verma (1988) of $n = 58$, from Jamunotri, Uttarakhand, is considered to have been in error (Fraser-Jenkins 1997: 184).

N. lanuginosa (Desf.) Desv. *ex* Poir. (syn.: *N. vellaea* (Aiton) Desv., non R.Br.; *Cosentinia vellaea* (Aiton) Tod.). Pichi Sermolli (1985) treated this species as a separate genus, *Cosentinia*, which he revived from earlier Italian literature, on the basis of its more trilete spores, but this has seldom been accepted. Morocco; Tunisia; Libya; Macaronesia; across S. Europe; Turkey; Cyprus; Lebanon; Syria; Israel; Yemen; Sudan; Iran; Afghanistan; Pakistan; N.W. India (Himachal Pradesh). A typical Mediterranean European element in the W. Himalaya. There are two subspecies, the tetraploid subsp. *lanuginosa*, which occurs throughout the range, excluding Pakistan and India, and the very closely similar, and cryptic diploid subsp. *bivalens* Reichst. (Badré & Reichstein 1983), apparently confined to Macaronesia, Spain and the Indian subcontinent.

A further species is the Chinese *N. sargentii* (Christ) Fras.-Jenk. (1997). Two additional Australian species, ***Notholaena muelleri*** (Hook.) Fras.-Jenk., ***comb. nov.***, basionym: *Gymnogramma muelleri* Hook., *Sp. Fil.* 5: 143, *t.* 295 (1864), and *N. reynoldsii* F.Muell., were formerly placed in the genus *Paraceterach*, which was treated as endemic to Australia, but *N. marantae* and four other species were placed within *Paraceterach* by Tryon (1986) in order to accommodate his misapplication of *Notholaena*.

2. *Cheilanthes* Sw., which includes *Cheilosoria* Trevis. and *Mildella* Trevis., normally consists of efarinose species in Asia, with generally narrow stipe-scales and small segments. The 11 species present in the Indian subcontinent are:

C. pteridioides (Reichard) C.Chr. subsp. *acrosticha* (Balb.) O.Bolòs (syn.: *C. acrosticha* (Balb.) Tod.,). W. Himalaya westwards to Mediterranean S.W. Asia and Europe, N. Africa and the Cape Verdes Islands. Subsp. *pteridioides* (syn.: *C. fragrans* (L.f.) Webb & Berth., *non* Sw; *C. maderensis* R.Lowe; *Negripteris quezelii* Tardieu) occurs from Mediterranean S.W. Asia, west across Mediterranean Europe to Macaronesia and across N. Africa, but is not present in the Indian subcontinent or near to it. The two subspecies are different cytotypes with a close reticulate relationship and are very similar to each other, differing only in the length of the indusium. They have thus been much confused in earlier literature, usually under the name *C. fragrans*, which is illegitimate. Following the rejection by Committee of Nardi & Reichstein's (1986) proposal to reject *Polypodium pteridioides* Reichard, in order to preserve their nomenclature, the nomenclature of this critical complex is now stable at either the specific or subspecific rank.

C. persica (Bory) Mett. *ex* Kuhn (syn.: *C. szovitzii* Fisch & C.A.Mey.). Far N.W. Himalaya, ?Himachal Pradesh, W. Asia, E. Mediterranean Europe and N. Africa. The lamina bears many long, pale hairs beneath.

C. tibetica Fras.-Jenk. & Wangdi, ***nom. nov.***, for *Pellaea straminea* Ching, *Bull. Fan Mem. Inst. Biol., Bot.*, 2: 203, *t.* 17 (1931), *non Cheilanthes straminea* Brause [= *Woodsia indusiosa* Christ] (syn.: *Mildella straminea* (Ching) C.C.Hall & Lellinger). S. and S.E. Tibet (type) and Bhutan. Newly reported here from the Indian subcontinent in

W. Bhutan (Chele La Pass, Ha District, *T. Wangdi*, *CRFJ* no. 31625, 12 Oct. 2005, THIM, TAIF, det. CRFJ). Specimens from S. Tibet by the N. Sikkim border and from Lhasa in Herb. Lloyd Botanic Garden, Darjeeling (!). Lamina pale-green, with long rather unlobed pinnules, a pale-brown stipe and rachis and hair-tipped, linear red-brown scales up the stipe; fronds deltate-lanceolate, bipinnate; indusia both short and long, arising at the curled over laminar edge rather than shortly within it as in other species formerly placed in *Mildella*.

C. nitidula Hook. subsp. *nitidula* (syn.: *Pellaea nitidula* (Hook.) Baker; *Mildella nitidula* (Hook.) C.C.Hall & Lellinger), from the W. Himalaya only, reaching eastwards to W. Nepal.

C. nitidula* subsp. *henryi (Christ) Fras.-Jenk., ***comb. nov.***, basionym: *Pellaea henryi* Christ, *Bull. Herb. Boissier* 7: 7 (1890) (syn.: *Mildella henryi* (Christ) C.C. Hall & Lellinger). N.E. India (Arunachal Pradesh), Bhutan (Thimphu, Taba, *CRFJ* 31496, 8 Oct. 2005, THIM, TAIF), S.E. Tibet, S. China (Yunnan (type), Szechuan, Kweichow, Kwangtung, Fukien), Taiwan, Vietnam. Reported from Namdapha, Arunachal Pradesh, by Singh & Panigrahi (2005) *sub Aleuritopteris albomarginata* (C.B.Clarke) Ching in error. Their drawing shows *A. albomarginata* from some other source, that being a higher altitude species they could not have found in the lower reaches of Namdapha they visited. However their photograph is of *C. nitidula* subsp. *henryi*, whose presence at Namdapha has been verified by CRFJ, from specimens previously cited by Chauhan (1996), but misreported by them as the Afro-Arabian *C. farinosa* (Forssk.) Kaulf. Very close to subsp. *nitidula* and differing only in the rachis hairs being denser and more prominent and sometimes extending further around the sides of the rachis and the smaller fronds with slightly less lobed pinna and pinna-lobes. This subspecies is a vicariant of subsp. *nitidula* and replaces it in the eastern part of its range. Previous records and collections of *C. nitidula* from further east referred to the present subspecies, which merges into it morphologically. The interesting bicentric range of this species is a well known distribution-pattern for species that prefer a somewhat drier climate and thus occur scattered behind the Himalayan line in the otherwise wetter parts of the central and east Himalaya.

C. opposita Kaulf. (syn.: *C. mysurensis* Wall. *ex* Hook., *C. fragrans* Sw.). Sri Lanka, S. India (N. to Orissa), S. China (Yunnan, Hainan, Kwangtung, Fukien), Taiwan, Myanmar and the Philippines. This beautiful species with narrow, upright and finely dissect, bright green leaves has been nomenclaturally confused until recently (see Fraser-Jenkins 1997), though its nomenclature was clarified by Alston (1936) and in detail by Fuchs (1961). Its range has sometimes been given as throughout China and other areas in error for the closely related, but less dissect *C. chusana* Hook.

C. tenuifolia (Burm.f.) Sw. Sri Lanka, through most of the Indian subcontinent except the N.W., China, Taiwan, S.E. Asia, Australia, New Guinea and Oceania. Although reported as diploid apomict by Verma (1961) it is now known that this species is tetraploid sexual in India and Sri Lanka, but like apomictic species produces only 32 spores per sporangium, as do several other sexually reproducing *Cheilanthes* species.

C. hancockii Baker. Newly reported from the Indian subcontinent, from Taba, Thimphu, Bhutan, *CRFJ* 31497, 8 Oct. 2005, THIM, TAIF; previous records from the E. Indo-Himalaya were in error for *Aleuritopteris bicolor*. S.W. China. ?N. Thailand (*C. delicatula* Tagawa & K.Iwats., which may otherwise be distinct).

C. belangeri (Bory) C.Chr. (syn.: *C. varians* Hook.). N.E. India, from Nepal eastwards; Bangladesh; Myanmar; S.E. China; Thailand; and S.E. Asia to the Philippines.

Reported from S. India by Beddome (1864) in error for *C. thwaitesii* (below), which he included within his concept of this species.

C. trichophylla Baker (syn.: *Pellaea trichophylla* (Baker) Ching; *Cheilanthes undulata* C.Hope & C.H.Wright). S.W. China. Reported tentatively by *S.C. Verma* in Mehra & Bir (1964), from the Kyangnosla pass, below Chhangu [Tsomgo] Lake, E. Sikkim (Verma, pers. comm. to CRFJ, 2004), but the specimen lost and unverified, though perhaps correctly recorded due to its distinct appearance, as recalled by Verma and illustrated in a drawing in his unpublished Ph.D. thesis of 1962 at Panjab University, Chandigarh. Distinctive zig-zag rachides and the axes and deeply tripinnatifid lamina densely covered in short yellowish-brown hairs.

C. bhutanica Fras.-Jenk. & Wangdi, ***nom. nov.***, for *Pellaea yunnanensis* Ching, *Act. Phytotax. Sinica* 20(2): 235 (1982), *non Cheilanthes yunnanensis* Brause [= *Aleuritopteris subvillosa* (Hook.) Ching]. China (Yunnan (type), Szechuan), Bhutan. Newly discovered from the Indian subcontinent by CRFJ as a common species of rocks and walls around Thimphu and elsewhere in W. Bhutan (Serbithang, *CRFJ* 31487, 8 Oct. 2005, with *T. Wangdi*; Taba, *CRFJ* 31570, 11 Oct. 2005; Paro, *CRFJ* 31596, 12 Oct. 2005, with *R. Pradhan* & *T. Wangdi*; Chuzzom, *CRFJ* 31676, 15 Oct. 2005, with *T. Wangdi*, THIM, TAIF). A small plant similar to a coarser-segmented and slightly less dissect *C. nitidula* with more deltate fronds and no hairs above the axes; sori and indusia continuous around the edges.

C. thwaitesii Mett. *ex* Kuhn (syn.: *Cheilanthes laxa* T.Moore *ex* Bedd., *nom. superfl.* for *C. thwaitesii*; *Cheilanthes keralensis* N.C. Nair & S.R. Ghosh, *Aleuritopteris thwaitesii* (Mett. *ex* Kuhn) Saiki). Sri Lanka (type) and South India; a Hindu-Lankan endemic. Type from Sri Lanka. This often overlooked species is important in illustrating that the presence or absence of farina is not confined to *Aleuritopteris*, but also occurs in some true *Cheilanthes* species.

3. *Aleuritopteris* Fée, formerly treated by most authors as *Cheilanthes* subgen. *Aleuritopteris* (Fée) W.C.Shieh, and all the species, except *A. stenochlamys* Ching *ex* S.K.Wu, have names in *Cheilanthes*. But it was recognised generically by Ching in Ching & Wu (1981, 1983) and subsequent Chinese workers and Saiki (1984). It appears likely that it constitutes a distinct, if probably heterogeneous entity, which being easily recognisable is practicably and usefully recognisable as a genus. The species are usually well-marked and readily distinguishable by their stipe-scales (bicolorous or concolorous) and their distribution up the axes, though most were at one time referred to the African and Arabian species, *A. farinosa* (Forssk.) Kaulf., which does not occur in Asia. The genus includes *Sinopteris* C.Chr. & Ching and *Leptolepidium* Ching & S.K.Wu (in the sense of its type species and also in the sense of Ching & Wu, which was based on a misapplication of the name *Cheilanthes dalhousiae* Hook.). It also has two sections, the first being the less dissect, more palmate species related to *A. argentea* (below) and the rest being the more pinnate species along the pattern of *A. farinosa*. Morphologically *Aleuritopteris* is slightly difficult to define in a way that distinguishes it from some species of *Doryopteris*, which are rather close to the *A. argentea* group, but are perhaps more likely to be related to the imparipinnate genus, *Pellaea*. Most species have rather wide segments and a strong white or yellow farina, with wide stipe-scales. Due to considerable lack of clarity and confusion, the cytology and reported aneuploid base-numbers for various species need to be carefully reinvestigated with accurate identification and preservation of voucher-specimens. The 18 species present

in the Indian subcontinent have mostly been detailed by Fraser-Jenkins (1992, 1993 and 1997) and are:

A. argentea (S.G.Gmel.) Fée (syn.: *A. flava* (Ching & S.K.Wu) S.R.Ghosh, *non* Saiki, *nec sensu* Ghosh [= *A. subargentea*]). Far N.E. India, a single collection of *J.D. Hooker & T. Thomson*'s from the Khasi Hills, Meghalaya (K!), might be correctly localised, but it has never been collected since in this generally well known area and is normally a higher-altitude, and usually higher latitude species. A similar case occurs with their collection at Kew of *Lycopodium annotinum* L. subsp. *alpestre* (Hartm.) Å. Löve & D. Löve, said to be from Khasia, but almost certainly from N. Sikkim. However *A. argentea* (S.G.Gmel.) Fée, which otherwise occurs in W., S.W., C., N. and E. China; Tibet; Taiwan; Korea; Japan; and Siberia, has now been discovered in Bhutan (Taba, near Thimphu, *CRFJ* 31500, 8 Oct. 2005, THIM, TAIF), and was previously collected from N. Lohit, at the Tibetan border in or on the border of Arunachal Pradesh (*F. Kingdon-Ward*, BM!). A further species, close to *A. argentea*, but without white farina and with small, narrow, less lobed segments has also turned up in N.E. Arunachal Pradesh (Changlang, Namdapha, Shirung to Hunung, c. 1100 m., *B.K. Shukla* 88207, 7 Feb. 1986, ASSAM, det. CRFJ). It appears to belong to the efarinose Chinese species, *A. shensiensis* Ching, though further comparative study may be required.

A. subargentea Ching *ex* S.K.Wu. Similar to *A. argentea* but slightly more dissect and the frond slightly more pinnately arranged, less palmate. Newly discovered in the Indian subcontinent (Marpha to Tukuche, Mustang, N.C. Nepal, *CRFJ* 30509, 27 June 2004, with *G. Tamang*, TAIF); Songgong, Sikkim, 1,400ft, *Ribu & Rhomoo Lepcha*, for *G.H. Cave* 7634, 4 Oct. 1923 (Herb. Lloyd Botanic Garden, Darjeeling!, det. CRFJ). Tibet; S.W. China.

A. tamburii (Hook.) Ching. N.C. Nepal; N. Sikkim; Meghalaya; Tibet and S.W. China. A very distinctive, large species of the *A. argentea* group, with wide, coarse lobes and bright white farina.

A. subvillosa (Hook.) Ching (syn.: *A. tenella* (Ching & S.K.Wu) Saiki). W. to E. Indo-Himalaya; Tibet; S.W. China. Efarinose, but closely related to the farinose *A. caesia* (Christ) Ching and *A. kuhnii* (Milde) Ching, from Tibet and S.W. or C. to N.E. China; Japan (the latter reported from India in error for *A. dalhousiae* by Dixit (1984)).

A. duthiei (Baker) Ching. W. Indo-Himalaya (very rare); N.W. Nepal; Bhutan. Efarinose, related to *A. leptolepis* (Fras.-Jenk.) Fras.-Jenk., but with a wider-triangular and more dissect lamina; both have wide, pale stipe-scales.

A. leptolepis (Fras.-Jenk.) Fras.-Jenk. (2008) (misapplied name: *A. dalhousieae* (Hook.) Ching, *nom. utrique rejic.*). The totally efarinose, higher-altitude species long known as *A. dalhousieae* ["*dalhousiae*"] in error due to Hooker's confusing the efarinose Summer (monsoon) fronds of *A. albomarginata* (below) with this species. W. to E. Indo-Himalaya; Myanmar; Tibet; S.W. China. Misreported sub "*C. dalhousiae*" *sensu auct. Ind.* by Dixit (1996) from Orissa, in error for *A. bicolor* with the powder washed off by alcohol during herbarium-poisoning.

A. rufa (D.Don) Ching. Common from the W. to E. Indo-Himalaya; also in S.W. China; Myanmar; Thailand. The fronds are lanceolate, narrowing slightly to the base, and the axes are densely covered with narrow, hair-like, fibrillose scales.

A. dubia (C.Hope) Ching (syn.: *A. subrufa* (Baker) Ching; *C. leveillei* Christ; *A. humatoides* Saiki; *C. wusukungii* Miyamoto & Ohba). Intermediate between the last and next species and sharing the same phytochemistry of its white flavonoid powder (Fraser-Jenkins & Wollenweber in prep.). W. to E. Indo-Himalaya; N. Western Ghats;

Myanmar; Tibet; S.W. and S. China; Taiwan; Thailand; the Philippines. Confused in China and reported as the next species.

A. albomarginata (C.B.Clarke) Panigrahi (syn.: *A. dalhousieae* (Hook.) Ching, *nom. utrique rejic., non sensu auct. Ind.*). Widespread at somewhat higher altitudes from the far W. to N.E. Himalaya; Orissa; N. Western Ghats; Tibet; S.W. China; Taiwan; Thailand; Vietnam. The fronds are deltate and instead of hair-like scales have bicolorous scales extending up the stipe, rachis and costae. The Summer (monsoon) fronds are taller and more developed and almost or quite without farina, unlike the smaller, basal Winter fronds.

A. chrysophylla (Hook.) Ching (syn.: *A. humatifolia* X.C.Zhang & L.Shi; *A. flavopygmaea* S.R.Ghosh). The only species with bright sulphur-yellow farina beneath in the Indian subcontinent. The W. Indo-Himalaya (Simla); C. Nepal to N.E. India; Myanmar; Tibet; S.W. China; Thailand.

A. formosana (Hayata) Tagawa (syn.: *C. brevifrons* (Khullar) Khullar). One of the most widespread species, frequently reported from China under the name *A. anceps* in error. W. Africa (Guinea); far W. to the E. Indo-Himalaya; Rajasthan (*C.S. Dulawat*, det. CRFJ); Uttar Pradesh; Bihar (Parasnath); Orissa; N.W. Ghats; Arunachal Pradesh; Tibet; S.W. and S. China; Taiwan; Myanmar; Thailand; the Philippines. It is fairly close to *A. anceps*, but has a narrower and usually smaller frond, which is characteristically bullulate-wrinkled above, and the slightly narrower, bicolorous stipe-scales extend up the rachis as well, but not (except rarely an odd one) onto the costae. The rachis usually bears scattered glands.

A. anceps (Blanf.) Panigrahi (syn.: *A. pseudofarinosa* Ching & S.K.Wu; *A. interrupta* Saiki; ?*A. javanensis* Saiki, *non C. javanensis* (Willd.) T.Moore). Widespread at lower altitudes in India *etc.*, far W. to N.E. Himalaya; Rajasthan; N.W. Ghats; C. India; S. India; Sri Lanka; Tibet; S.W. China (rare); Taiwan; Myanmar; Thailand; ?Java; ?Timor. The lamina is deltate-lanceolate, but not as triangular and wide-based as in *C. bicolor* (below), and has a brighter white farina; the slightly wide, bicolorous stipe-scales do not normally extend above the top of the stipe.

A. dealbata Fée (syn.: *C. dealbata* D.Don, non Pursh; *A. doniana* S.K.Wu *ex* Ching, *nom. superfl.*; *C. doniana* Fras.-Jenk. & Khullar; *A. sikkimensis* S.R.Ghosh). E. part of the W. Himalaya (Uttarakhand); Nepal to N.E. India; Tibet; S.W. China; Myanmar; ??Thailand. This species is closely related to *C. anceps*, but has a longer, often very large frond and wider, less lobed segments, with narrower indusia, and a very bright white farina. The stipe-scales, though vaguely bicolorous, do not have such an obvious dark central stripe and tend to have a yellower basal region and slightly darker apical region. It was illustrated from Nagarjun, Kathmandu, Nepal, on the front dust-jacket by Fraser-Jenkins (1997).

A. bullosa (Kunze) Ching (syn.: ?*A. indica* Fée; *A. flaccida* (Bedd.) B.K.Nayar & S.Kaur; *C. flaccida* (Bedd.) Mehra & Bir, *non sensu* Mehra & Bir [= *A. bicolor*]). Sri Lanka and S. India. A very large species with long fronds, a bullulate upper surface, well lobed pinnules, thick stipes and concolorous red stipe-base scales.

A small-sized, more creamy-yellowish powdered segregate of *A. dealbata* from S. India (especially the Shevaroy Hills) is *A. wollenweberi* Fras.-Jenk. (2008), superficially similar to the Chinese, Taiwan and Japanese *A. krameri* (Franch. & Sav.) Ching.

A. stenochlamys Ching *ex* S.K.Wu. E. part of the W. Himalaya (Uttarakhand); Nepal; Bhutan; Manipur; Tibet, S.W. China. This rare, high-altitude taxon is closely related to *A. grisea* and is perhaps of slightly doubtful status, requiring further study, though

possibly a good species. Fraser-Jenkins previously confused its type and used the name *C. stenochlamys* for it in error.

A. grisea (Blanf.) Panigrahi, *non sensu* Panigrahi (syn.: *A. platychlamys* Ching; *C. platychlamys* (Ching) Fras.-Jenk.). A high-altitude Himalayan species with concolorous red stipe-scales; widely misrecorded from C. or S. India and Orissa by Panigrahi (1965) and Dixit (1996) in error for *A. formosana* among other species. Far W. to E. Indo-Himalaya; Tibet, S.W. China; Taiwan.

A. bicolor (Roxb.) Fras.-Jenk., ***comb. nov.***, basionym: *Pteris bicolor* Roxb. in Griff., *Calcutta J. Nat. Hist.* 4: 507 (1844) (syn.: *Cheilanthes farinosa* var. *tenera* C.B.Clarke & Baker; *C. bicolor* (Roxb.) Griff. *ex* Fras.-Jenk.; *A. bicolor* (Roxb.) Punetha & Kholia, *comb. inval., sin. basionym*; *A. kathmanduensis* Ching & S.K.Wu; misapplied name: *Cheilanthes farinosa sensu auct. Ind. plur.*, Blanf. *et al.*, *non* (Forssk.) Kaulf.). A very common and widespread, rather low-altitude species in India. W. Africa (Nigeria, Jos); far W. to N.E. Indo-Himalaya; Rajasthan; Bihar (Parasnath); C. India; Orissa; S. India; Bangladesh; Myanmar; ?Thailand; Laos. A similar taxon, but more delicate and with russet, concolorous stipe-base scales (like those of *A. subdimorpha*) occurs in Sumatra. There is some apparent transition, or some intermediate taxon, between the otherwise highly distinct *A. bicolor* and *A. anceps* (and also somewhat towards *A. subdimorpha*) in S.E. Bangladesh (Chittagong Hills), S. India, Myanmar, S.E. China and ?New Guinea (Papua). But it is not yet clear why this should appear to be so.

A. subdimorpha (C.B.Clarke & Baker) Fras.-Jenk., ***comb. nov.***, basionym.: *Cheilanthes farinosa* (Forssk.) Kaulf. var. *subdimorpha* C.B.Clarke & Baker, *J. Linn. Soc., Lond.* 24: 411 (1888) (syn.: *Cheilanthes subdimorpha* (C.B.Clarke & Baker) Hieron.; *A. longipes* Ching & S.K.Wu, *nom. inval., sin. typ.* (which is not *A. bicolor*, as tentatively thought by Fraser-Jenkins 1997, in the absence of the type); *C. longipes* (Ching & S.K.Wu) Dixit & Bal Krishna, *comb. inval.*; *A. pentagona* Saiki; *A. pseudoargentea* S.K.Wu). From C. Nepal eastwards to N.E. India; Arunachal Pradesh; Manipur; abundant in Meghalaya; ?Bangladesh; Myanmar; Thailand; S.W. to S.E. China; Vietnam. This rather little known species is generally similar to *C. bicolor*, but has a longer, thicker stipe, shorter and more coarsely lobed lamina and concolorous, russet stipe-scales.

4. *Negripteris* Pic.Serm. is closely similar to *Aleuritopteris* but differs in having only rather few (1-4) sporangia per sporangium (also shown by some *Aleuritopteris*), which are rather deeply embedded in the laminar powder ("subsessile") and an apparently primitive, large sporangium, without a definite stomium area and a very broad annulus with all its walls thickened (indurated), including the outer one, appearing like a solid, dark cap to the sporangium. During dehiscence, the sporangium splits laterally and the whole annulus or top half of the sporangium falls off to release the spores. This may be a retained adaptive feature connected with a very dry climate, allowing protection of the developing sporangia against desiccation. However, on the strength of this hypothetically being supposed to be a very primitive characteristic Pichi Sermolli not only raised a new genus, but even a new family for the single specimen he had seen (which was undoubtedly and obviously mistaken), despite pointing out its evident similarity to *Aleuritopteris*. In all its other features it is not separable from *Aleuritopteris* in its concolorous, lanceolate, pale-reddish stipe-scales, frond-shape, white farina beneath and shallow, interrupted pseudo-indusia formed by the leaf-margin. Weatherby (1948) pointed out tendencies within what is now *Chrysochosma*

from N. America, towards a similar annulus and embedded sporangium, and pointed out the likeness of *N. scioana* to some "*Notholaena*" species (*i.e. Chrysochosma* spp.). While not in any way invalidating the genera *Aleuritopteris* and *Notholaena*, it must be said that a few species in either genus can hardly be distinguished morphologically from the other genus. The likelihood is therefore that *Negripteris* is either an *Aleuritopteris* or a *Chrysochosma*, or may perhaps be nearer to an ancient ancestor of both. However it is maintained here as a somewhat dubious genus, resting on its peculiar sporangia, pending further study. *A. rosulata* (C.Chr.) Ching (syn.: *A. pygmaea* Ching), from Tibet and S.W. China, has similar scales and lamina (with the lobes rather broadly joined at their bases and fusing at the apex as in *Negripteris*) and appears to be very close to it, but without the characteristic sporangia. A rare S.W. Chinese species, *A. sichouensis* Ching & S.K.Wu, is again similar and by definition only would most probably be placed in *Chrysochosma*.

N. scioana (Chiov.) Pic.Serm. (syn.: *Mohria scioana* Chiov.; *Negripteris tricholepifera* Pic.Serm.). An Afro-Arabian species, formerly known from N.E. Africa and South Arabia only: Ethiopia, Sudan, Somalia, Socotra (also seen there by the first author in 1967), N. Kenya, Yemen, Saudi Arabia. To this must now be added a remarkable discovery of it from W. India in the semi-arid hills of Rajasthan. Last year, Dr. C.S. Dulawat (the second author) sent the first author material of his Rajasthan *Aleuritopteris* for identification and most surprisingly there was some fine, unidentified material of typical *Negripteris scioana* (Chiov.) Pic.Serm. among them that he had collected from the Kumbhalgarh and Sitamata Sanctuaries, Aravalli Hills and Chittorgarh, Rajasthan. This discovery is of considerable phytogeographical interest as it was otherwise only known to be in N.E. Africa and S. Arabia and fits in with a small handful of other Afro-Arabian connections in Western India, mainly in Rajasthan. The photograph purported to be *Cheilanthes albomarginata* C.B.Clarke *sensu lato* published by Chaudhary & Khichi (2007) is actually of the tip of the frond of *Negripteris* from Sitamata. Specimens collected are:

1. Rajasthan, Sitamata Wild Life Sanctuary, Ambaretti, crevices of rocks, 500-800 m. *C.S. Dulawat* CSD/SM/05-147, 14 Oct. 2005, Herb. Botany Dept., M.L.S. University, Udaipur.

2. Rajasthan, Sitamata Wild Life Sanctuary, Ambaretti, crevices of rocks and bank of *nalah* [stream], c. 500-800m. *C.S. Dulawat* CSD/SM/06-197, 5 Oct. 2006, Herb. Botany Dept., M.L.S. University, Udaipur.

3. Rajasthan, Khumbhalgarh Wild Life Sanctuary, Ranakpur Ghat, crevices of rocks, 550-800 m. *C.S. Dulawat & B.L. Chaudhary* CSD/SM/05-183, 23 Oct. 2005, BSD.

5. *Doryopteris* J.Sm. Characterised by the long, uninterrupted sori and often palmate fronds, but though widely and usefully accepted, is difficult to define exclusively, especially in relation to the *Aleuritopteris argentea* group, which also contains some efarinose species. Two species occur in the Indian subcontinent:

D. concolor (Langsd. & Fisch.) Kuhn (syn.: *Doryopteris geraniifolia* (Raddi) Klotzsch). S. and C. America; Africa; Sri Lanka; S. India (N. to Orissa); S. China; throughout S.E. Asia; Australia; Oceania. *D. kirkii* (Hook.) Alston from Africa has occasionally been reported from India in error for *D. concolor*, but is anyway a somewhat doubtful taxon. The taxonomic position of this fern has long been in some doubt as it is very similar to an efarinose member of the *Aleuritopteris argentea* group

and has often been placed in *Cheilanthes*. Pending further study, including molecular DNA work, it is maintained here in *Doryopteris*, where it appears most likely to belong and has more usually been placed.

D. ludens (Wall. *ex* Hook.) J.Sm. A distinctive species with tall black stipes and black midribs and the horizontal frond varying from cordate to considerably and deeply palmate-pinnately lobed into long, narrow segments, the lowest lobe basiscopically lobed again and the fertile fronds taller and more narrowly lobed than the sterile. It occurs in Orissa (Dixit 1996) and from N.E. India eastwards; Assam; Manipur; Nagaland; Tripura; Mizoram; Bangladesh; Myanmar; S.W. and S. China; Thailand; and S.E. Asia. Hope (1901) reported it from Chitral, N.W. Pakistan, in error on the basis of a specimen given to him by General Gatacre, ostensibly collected during the Chitral Relief Military Expedition, at Kaffir Rock on the road S. of Ziarat, along with *Lygodium microphyllum* (Link) R.Br. The specimens of both species, along with drawings and a sketch-map provided by Gatacre are in DD (!) and are correct. But anyone who knows the Pakistan fern-flora (Fraser-Jenkins 1992, 1993) and who has been there, where Kaffir Rock still exists beside the main road into Chitral from the Lowarai Pass, would know that neither species could possibly occur there or anywhere within thousands of miles. The specimens were almost certainly collected during Gatacre's duty in Myanmar shortly previous to the Chitral expedition and seem most likely to have been more in the way of a "military prank", than due to confusion. It is surprising that such an experienced expert as Hope could possibly have swallowed it!

6. *Pellaea* Link, *nom. cons.* Although various species, including those subsequently placed in *Mildella* by Hall & Lellinger (1967) and now in *Cheilanthes*, have been put into *Pellaea* in the past because of their glabrous, efarinose segments with long sori, the genus is now confined to those species with imparipinnate fronds, the apical segment being similar to a lateral one. The species may be glabrous or hirsute. Ghosh (1985) claimed to have "done" the taxonomy of Indian *Pellaea* and listed 3 species, but the 5 species occurring in India are as follows:

P. falcata (R.Br.) Fée (syn.: *P. seticaulis* (Hook.) S.R.Ghosh). This species has simple, unlobed, elongated, nearly glabrous pinnae with a only few hair-like scales beneath, and a hairy and scaly stipe and rachis, similar in both Australasia and S. India. It is absent from Malaysia (given by Ghosh), Hooker's type-locality of "Penang" being in error for Lady Dalhousie's collection from Sri Lanka (from where it was reported by Sledge 1982), which was omitted by Ghosh (1985).

P. longipilosa Bonap. (syn.: *P. malabarica* B.K.Nayar & Geev.). Similar to *P. falcata*, but with narrow, tripartite lower and mid pinnae. Africa; S. India; confined to a few localities in Kerala. Though redescribed as if a new, endemic species, Fraser-Jenkins has reidentified it as being the African species, *P. longipilosa*, which is thus one of a rather small group of tropical African elements in S. India.

P. boivinii Hook. A rather small, bipinnate species with from 2 to 3 pairs of elongated ovate, articulated-stalked pinnules on the lower pinnae and all the axes densely covered in very short, dark, blackish-brown hairs. S. and E. Africa; Madagascar; Mascarenes; Sri Lanka (Sledge 1982, omitted by Ghosh 1985); and S. India. Another tropical African element in S. India.

P. viridis (Forssk.) Prantl. Another bipinnate species, with slightly larger, thinner and non-articulate-stalked, often biauriculate-based segments and glabrous axes. Adventive in S. India and Sri Lanka (Sledge 1982). Also naturalised in Australia and Oceania. S.

and E. Africa; Madagascar; and Yemen (type).
P. calomelanos (Sw.) Link *non Pityrogramma calomelanos* (L.) Link. (syn.: *P. hastata* (Thunb.) Prantl, *non* (L.) Thunb.). A rare and very seldom-collected species occurring in a few scattered localities in very dry rocky areas. The stalked leaf-segments are cordate-hastate and without scales, borne on glossy black costae. Africa; Pakistan (Swat; Hazara); Himachal Pradesh; Uttarakhand; W. Nepal; S.W. China. An Afro-Arabian element reaching the W. Himalaya.

7. *Pityrogramma* Link. The "silver ferns" and "gold ferns" of cultivation where they often spread by self-sporing. They are exindusiate and the sori spread along the veins and cover the whole surface beneath the segments. Four New World species are adventive in the Indian subcontinent:
P. calomelanos (L.) Link. The farina beneath the leaf, which is usually rather thin and weak, is white. S. and C. America. Adventive throughout the world in warmer climates and so abundant in even remote places throughout nearly all of the Indian subcontinent that it is sometimes difficult to remember that it is in fact an alien species not recorded before the later 19th Century.
P. austroamericana Domin (syn.: *Pityrogramma calomelanos* var. *austroamericana* (Domin) Farw.; *P. calomelanos* (L.) Kaulf. var. *aureoflava* (Hook.) Weath. *ex* F.M.Bailey; misapplied name: *P. chrysophylla* (Sw.) Link). The farina beneath the leaf is sulphur yellow. S. and C. America. A common adventive in Sri Lanka and S. India. In addition to the bright yellow powder, which is often lost in old specimens by treatment with alcohol (containing pesticides), it also has a shorter lamina with rather shorter and often less lobed segments. For some reason it has not reached N. India to date. It was first recognised as a separate species by Domin (1928, 1929) and detailed further in his later publications. The genus was monographed by Tryon (1962), and information was thence extracted by Panigrahi (1975) and from the determinations at Kew.
P. dealbata (C.Presl) R.Tryon. White farina, a small, thin lamina with well lobed and toothed segments. C. America. Adventive in Sri Lanka, but probably not well established.
P. sulphurea (Sw.) Maxon. Pale lemon-yellow, rarely white farina and the frond narrowed towards the base, with the ultimate segments cuneate-based and fanned out or flabellate at their strongly toothed apices. C. America. Adventive in Samoa and Sri Lanka, but probably not well established in the latter.

8. *Parahemionitis* Panigrahi. Following Mickel's (1974) establishing that the Indian species is not a true *Hemionitis*, and Tryon, Tryon & Kramer's (1990) clear statement that "*H. arifolia*" is not readily included in any genus. Panigrahi (1993) took it upon himself to utilise that information and make several attempts to interject a new generic name of his own for it (see Fraser-Jenkins 1997: 187-188), finally succeeding in validating one. *Parahemionitis* is therefore accepted here as the name for the genus and its single species-complex.
P. cordifolia (Roxb.) Fras.-Jenk. (misapplied name: *Hemionitis arifolia* (Burm.f.) T.Moore). Distinctive cordate-rounded leaves. N.E. India (Bihar; Assam; Manipur; Nagaland; Tripura; Mizoram); Sri Lanka; S. India; Bangladesh; Myanmar; S. China; Vietnam; Malesia; Philippines. The widespread Indian triploid cytotype may often be proliferous with small plantlets developing in the axil of the leaf during the wet season.

but dropping off during the dry season. A Chinese diploid, which is more delicate, is never proliferous (Huang, Manickam & Chiou 2007).

9. *Hemionitis* L. (syn.: *Gymnopteris* Bernh.; *Gymnogramme* Desv.). The detailed work carried out by Mickel and his colleagues (Mickel 1974, 1988, Gianassi & Mickel 1979, Ranker 1989) on this genus has been usefully summarised in Pichi Sermolli & Bizzarri's (2005: 66-68) final *magnum opus*. One species in the Indian subcontinent: *H. tomentosa* (Lam.) Raddi (syn.: *Gymnopteris tomentosa* (Lam.) Underw.) S. America. Adventive and very common in Sri Lanka.

CONCLUSION

The discovery of the African *Negripteris* in India is not only of considerable phytogeographical interest, but also suggests that further collection and study by Indian pteridologists with a specialist knowledge, able to recognise all the species they see, may reveal a number of other species hitherto overlooked in the subcontinent. The discovery of *Notholaena borealisinensis*, *Cheilanthes hancockii*, *C. bhutanica*, *C. tibetica* and *Aleuritopteris subargentea*, all previously unknown in the Indian subcontinent are further examples.

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CHECKLIST OF THE FERNS AND LYCOPHYTES OF ACRE STATE, BRAZIL

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ABSTRACT

One hundred and seventy eight species and five varieties in 24 families and 60 genera of ferns and lycophytes are recorded for state of Acre, Brazil. Data about habit, habitat, material examined, and distribution of each taxon are also presented. Acre contains about one-third of the species of ferns and lycophytes estimated to occur in the Brazilian Amazon region.

INTRODUCTION

The Project of the Flora of Acre State, Brazil, is a collaborative endeavour between the Federal University of Acre (UFAC) and The New York Botanical Garden (NY). For some groups of plants, specialists were invited to contribute, such as for ferns and lycophytes. This checklist is a result of the collaborative project.

The first expeditions to Acre and the Brazilian Amazon took place in 1900-1901 when Ernest Heinrich Georg Ule collected along the rivers Tejo and Juruá-Mirim. Locally, this area is called "Região do Alto Rio Juruá." In 1911-1912, a second expedition was conducted by Ule in the region of the Acre River. The first Brazilian botanist to explore the state was João Geraldo Kuhlmann, who travelled with Marechal Rondon through Amazonia in 1923. Later, in 1933, Boris Alexander Krukoff collected in the region, especially around the Macauã River, in the Basin of Purus River. During the 1960s and 1970s, several botantists collected in Acre State, the most prominent being João Murça Pires, Ghillean T. Prance, Enrique Forero, Paul J. Maas, and Paulo G. Windisch. Other important collections from Acre were made for the Project RADAMBRASIL during the 1970s by Luis Coêlho, Cid Ferreira, Bruce Nelson, and Thomas Croat. They were among the members of three expeditions to Acre (Silveira, 2003).

In 1979 the Herbarium of the Federal Universty of Acre (HPZ) was established. Its main goal was to have a reference collection for the flora of Acre. In 1990 the herbarium signed an international agreement of cooperation with The New York Botanical Garden (NY) to promote studies of the Acre flora. During the last twenty years Douglas Daly (NY), Marcos Silveira (UFAC), and several other collaborators from many institutions have greatly increased the number of collections in Acre. According to Daly (personal communication), at the beginning of the project "Floristics and Economic Botany of Acre, Brazil" the Herbarium of the Federal University of Acre (HPZ) had 2,000 specimens. It now has more than 30,000 specimens, including non-vascular and vascular plants.

These collections provided many new records of ferns (e.g., *Adiantum decoratum*

Maxon & Weath., *A. poeppigianum* (Kuhn) Hieron. *A. scalare* R. M. Tryon, *Bolbitis oligarchica* (Baker) Hennip., *Tectaria draconoptera* (D. C. Eaton) Copel., *Thelypteris membranacea* (Mett.) R. M. Tryon; Labiak & Prado, 2007) and new species (e.g., *Adiantum windischii* J. Prado and *Triplophyllum boliviense* J. Prado & R. C. Moran; Prado, 2005; Prado & Moran, 2008).

Acre State is located in northwestern Brazil in the southwestern part of the Brazilian Amazon. It covers an area about 153,149 km^2 and harbours great variation in topography, soils, and climates. This variation promotes a high diversity of vegetation types, floristic affinities, and life forms. Several factors divide the state into two regions: the southeastern region is drained by the Purus River and by the Basin of the Rivers Acre/Purus. Here there is a pronounced dry season, and several species are shared with Central Brazil and with other extra Amazonian vegetation types (Prado & Gibbs, 1993). The second region is northwestern Acre, drained by the Juruá River. This area is continuously wet, lacking a dry season. Along its border with Peru are the mountainous Moa Range and Divisor Range (locally called the *Serra do Moa* and *Serra do Divisor*, respectively). These ranges shelter several Andean species and genera such as *Cyathea bipinnatifida* (Baker) Domin (Cyatheaceae), *Pteris haenkeana* C. Presl, (Pteridaceae), *Solanopteris bifrons* (Hook.) Copel. (Polypodiaceae); flowering plant examples include *Croton lechleri* Müll Arg. (Euphorbiaceae), *Ladenbergia lambertiana* (A. Braun ex Mart.) Klotzsch, *L. oblongifolia* (Rubiaceae), and *Monolena primuliflora* Hook. f. (Melastomataceae)). This region has open vegetation called "Campinas" and "Caatingas Amazônicas" on whitish sandy soils. The flora of this region has affinities with those of the Rivers Rio Madeira and Negro (Silveira, 2003).

The preliminary checklist of the Acre Flora (http://www.nybg.org/bsci/acre/www1/checklist.html), which includes all vascular plants and fungi, lists about 3,273 species (including infraspecific taxa), of which 156 are either ferns or lycophytes, these belonging to 50 genera.

In general, ferns and lycophytes from Acre are poorly known and papers containing some information about them are few and sparse (Tryon & Conant, 1975; Windisch, 1979; Prado, 2005, and Labiak & Prado, 2007). The present study revealed 178 species, 60 genera, and five varieties in 24 families (Table 1). According to our estimates, Amazonian Brazil has ca. 550 species of ferns and lycophytes; thus, Acre contains about 32% of that total number.

LIST OF SPECIES

The present list is based on material from the following herbaria: CEN, HB, HPZ, HRCB, INPA, K, MG, MO, NY, R, RB, SP, UC. In 2001 the senior author collected about 250 specimens in Acre. In total, about 820 specimens have been examined for the present checklist.

The list is organised in alphabetic order by families, genera, species, and varieties. The arrangement of familes and genera follows Smith *et al.* (2006). For each species and variety the full name of the taxon is presented with the reference of the original publication, as well as additional information such as: habit, habitat, material examined, and geographic distribution. Voucher information for each species and variety is organised in alphabetic order by municipality; material collected by same collector for the same locality appears in ascending numerical order.

Author abbreviations follow Pichi-Sermolli (1996). In general, synonyms are omitted, except the basionym of the accepted name.

Table 1. Synopsis of taxa in Acre State, Brazil.

Families	Number of genera	Number of spp.	Number of varieties
Anemiaceae	1	1	
Aspleniaceae	1	11	
Blechnaceae	2	3	
Cyatheaceae	2	4	
Dennstaedtiaceae	2	2	
Dryopteridaceae	10	21	1
Gleicheniaceae	2	2	
Hymenophyllaceae	4	17	
Lindsaeaceae	1	7	3
Lomariopsidaceae	3	8	
Lycopodiaceae	2	2	
Lygodiaceae	1	2	
Marattiaceae	1	3	
Metaxyaceae	1	1	
Polypodiaceae	9	28	
Psilotaceae	1	1	
Pteridaceae	8	30	
Saccolomataceae	1	3	
Salviniaceae	1	1	
Schizaeaceae	1	1	
Selaginellaceae	1	7	
Tectariaceae	2	6	
Thelypteridaceae	1	12	1
Woodsiaceae	2	5	
Totals: 24	60	178	5

ANEMIACEAE

Anemia phyllitidis (L.) Sw., Syn. Fil. 155. 1806.
Osmunda phyllitidis L., Sp. Pl. 1064. 1753.
Habit/Habitat: Herb; terrestrial on riverside vegetation and on Terra Firme forest.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9779* (HPZ, NY); Brasiléia, *D. C. Daly et al. 9895* (HPZ, NY).
Distribution: Mexico, Greater Antilles, except Puerto Rico, Mesoamerica, tropical and subtropical South America.

ASPLENIACEAE

Asplenium angustum Sw., Vet. Ak. Handl. 38: 66, tab. 4, fig. 1. 1817.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12637* (NY); Mâncio Lima, *D. C. Daly et al. 8953* (HPZ, NY).
Distribution: N South America.

Asplenium auritum Sw., J. Bot. (Schrader) 1800(2): 52. 1801.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11466* (NY); Mâncio Lima, *G. T. Prance et al. 11977* (NY); Marechal Thaumaturgo, *D.C. Daly 10531* (NY); Porto Valter, *P. J. M. Maas et al. P12930* (MG, NY), *P. J. M. Maas et al. P13180* (NY); Santa Rosa, *D. C. Daly et al. 11305* (NY); Sena Madureira, *M. Silveira et al. 617* (HPZ, NY); Tarauacá, *G. T. Prance 7247* (MG, NY), *G. T. Prance et al. 7382* (NY), *M. Silveira et al. 921* (NY).
Distribution: S Mexico, Antilles, Mesoamerica, N South America.

Asplenium cirrhatum Rich. ex Willd., Sp. Pl. 5: 321. 1801.
Habit/Habitat: Herb; epiphyte on flooded vegetation.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12202* (NY); Mâncio Lima, *M. Silveira et al. 1245* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Asplenium cuneatum Lam., Encycl. 2: 309. 1786.
Habit/Habitat: Herb; epiphyte on Terra Firme.
Material examined: BRAZIL. ACRE: Porto Valter, *P. J. M. Maas et al. P13103* (NY).
Distribution: Antilles, Mesoamerica and tropical South America, Polynesia, Africa.

Asplenium delitescens (Maxon) L. D. Gómez, Brenesia 8: 52. 1976.
Diplazium delitescens Maxon, Contr. U.S. Natl. Herb. 10: 497. 1908.
Habit/Habitat: Herb; terrestrial grows riverside vegetation and on Terra Firme forest.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9811* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 7337* (HPZ, NY).
Distribution: S Mexico, Antilles, Mesoamerica, N South America.

Asplenium hallii Hook., Sp. Fil. 3: 202. 1860.
Habit/Habitat: Herb; epiphyte on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1166* (HPZ, SP), *J. Prado et al. 1306* (HPZ, SP), *J. Prado et al. 1379* (HPZ, SP), *L. R. Marinho 251*

(NY); *P. J. M. Maas et al.P12794* (NY); Mâncio Lima, *G. T. Prance et al. 2850* (MG, NY); *G. T. Prance et al. 12246A* (MG, NY); *J. Prado et al. 1225* (HPZ, SP).
Distribution: N South America.

Asplenium juglandifolium Lam., Encycl. 2: 307. 1786.
Habit/Habitat: Herb; epiphyte on flooded vegetation near river margins.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 8464* (HPZ, NY), *D. C. Daly et al. 9330* (NY); Cruzeiro do Sul, *G. T. Prance et al. 2786* (MG, NY); Mâncio Lima, *J. Prado et al. 1224* (HPZ, SP), *J. Prado et al. 1318* (HPZ, SP); Marechal Thaumaturgo, *D. C. Daly et al. 7764* (NY); Porto Acre, *A. R. S. Oliveira et al. 761* (NY); Rodrigues Alves, *J. Prado et al. 1262* (HPZ, SP).
Distribution: Mexico, Jamaica, Mesoamerica, tropical South America.

Asplenium ortegae Murakami & R. C. Moran, Ann. Missouri Bot. Gard. 80: 23. 1993.
Habit/Habitat: Herb; terrestrial .
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11707* (NY).
Distribution: N South America.

Asplenium pearcei Baker, Syn. Fil. (ed. 2) 483. 1874.
Habit/Habitat: Herb; epiphyte on trees in Terra Firme forests.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 11906* (NY); Cruzeiro do Sul, *J. Prado et al. 1350* (HPZ); Feijó, *P. Delprete et al. 8543* (NY); Mâncio Lima, *G. T. Prance et al.12168* (NY); Manoel Urbano, *D. C. Daly et al. 11226* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7336* (HPZ, NY); Porto Valter, *G. T. Prance et al. P13269* (NY), *P. J. M. Maas et al.P13295* (NY), *S. R. Lowrie et al. 525* (NY); Santa Rosa, *D. C. Daly et al. 9948* (NY); Tarauacá, *C. Herinhaus et al. 397* (NY); Without locality, *J. Jangoux et al. 85-096* (MG, NY).
Distribution: N South America.

Asplenium pedicularifolium St. Hilaire, Voy. Distr. Diam. 1: 380. 1833.
Habit/Habitat: Herb; epiphyte on forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8926* (HPZ, NY), *G. T. Prance et al. 12246* (NY).
Distribution: Guianas and Brazil.

Asplenium serratum L., Sp. Pl. 2: 1079. 1753.
Habit/Habitat: Herb; epiphyte on forest on Terra Firme and on flooded vegetation near river margins.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9808* (HPZ, NY); Brasiléia, *D. C. Daly et al. 6771* (HPZ, NY); Bujari, *D. C. Daly et al. 9328* (NY), *M. de Pardo et al. 80* (NY); Cruzeiro do Sul, *D. C. Daly et al. 11717* (NY), *G. T. Prance et al. 2785* (NY), *P. J. M. Maas et al. P12863* (MG, NY), *J. Prado et al. 1187* (HPZ, SP), *J. Prado et al. 1197* (HPZ), *J. Prado et al. 1317* (HPZ, SP), *J. Prado et al. 1340* (HPZ, SP), *J. Prado et al. 1382* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1135* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 9136* (NY), *D. C. Daly et al. 11241* (NY); Plácido de Castro, *C. Figueiredo & I. Riveiro 592* (NY), *L. G. Lohmann & E. C. de Oliveira 492* (NY); Rodrigues Alves, *J. Prado et al. 1237* (HPZ, SP), *J. Prado et al. 1255* (HPZ, SP), *J. Prado et al. 1291* (HPZ, SP); Santa Rosa, *D. C. Daly et al.*

10053(HPZ, NY), *D. C. Daly et al. 10984* (NY), *D. C. Daly et al. 11106* (NY); Sena Madureira, *D. C. Daly et al. 7841* (HPZ, NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Asplenium stuebelianum Hieron., Hedwigia 47: 222. 1908.
Habit/Habitat: Herb; epiphyte or terrestrial, in open forest with bamboo.
Material examined: BRAZIL. ACRE: Feijó, *D. C. Daly et al. 8500* (NY); Mâncio Lima, *D. C. Daly et al. 8952* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 10524* (NY), *D. C. Daly et al. 10552* (NY); Rio Branco, *D. C. Daly et al. 6871A* (HPZ, NY).
Distribution: Tropical South America.

BLECHNACEAE
Blechnum occidentale L., Sp. Pl. 2: 1077. 1753.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *P. J. M. Maas et al. P13242* (NY).
Distribution: S EUA, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Salpichlaena hookeriana (Kuntze) Alston, Bull. Misc. Inform. Kew 1932: 312. 1932.
Spicanta hookeriana Kuntze, Revis. Gen. Pl. 2: 81. 1891.
Habit/Habitat: Herb; climbing on flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1161* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1229* (HPZ, SP).
Distribution: N South America.

Salpichlaena volubilis (Kaulf.) J. Sm., J. Bot. (Hooker) 4: 168. 1841.
Blechnum volubile Kaulf., Enum. Filic. 159. 1824.
Habit/Habitat: Herb; climbing on flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1200* (HPZ, SP).
Distribution: Antilles, Mesoamerica, and tropical South America.

CYATHEACEAE
Alsophila cuspidata (Kunze) D. S. Conant, J. Arnold Arbor. 64: 371. 1983.
Cyathea cuspidata Kunze, Linnaea 9: 101. 1834.
Habit/Habitat: Tree-fern; forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 9881* (NY), *D. C. Daly et al. 11886* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7427* (HPZ, NY).
Distribution: Mesoamerica and tropical South America.

Cyathea microdonta (Desv.) Domin, Pteridophyta 263. 1929.
Polypodium microdontum Desv., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 5: 319. 1811.
Habit/Habitat: Tree-fern; forest near river margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1190* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 11558* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Cyathea pilosissima (Baker) Domin, Pteridophyta 262. 1929.
Polypodium pilosissimum Baker, Syn. Fil. ed. 2: 457. 1874.
Habit/Habitat: Tree-fern; in disturbed forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 11603* (NY); Rodrigues Alves, *J. Prado et al. 1231* (HPZ, SP).
Distribution: Mesoamerica and N South America.

Cyathea pungens (Willd.) Domin, Pteridophyta 263. 1929.
Polypodium pungens Willd., Sp. Pl. 5: 206. 1810.
Habit/Habitat: Tree-fern; flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 6823* (HPZ, NY), *L. Ferreira & L. C. Ming 117* (HPZ, NY); Mâncio Lima, *D. C. Daly et al. 1252* (NY); Manoel Urbano, *D. C. Daly et al. 9087* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10239* (NY); Santa Rosa, *D. C. Daly et al. 10165* (NY), *D. C. Daly et al. 11175* (NY).
Distribution: Antilles and N South America.

DENNSTAEDTIACEAE
Dennstaedtia bipinnata (Cav.) Maxon, Proc. Biol. Soc. Wash. 51: 39. 1938.
Dicksonia bipinnata Cav., Descr. Pl. 154. 1802.
Habit/Habitat: Tree-fern; flooded vegetation near stream margins.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11418* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Pteridium caudatum (L.) Maxon, Proc. U.S. Natl. Mus. 23: 631. 1901.
Pteris caudata L., Sp. Pl. 2: 1075. 1753.
Habit/Habitat: Herb; terrestrial in cleared land be-side tracks.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1178* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 2864* (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica and N South America.

DRYOPTERIDACEAE
Bolbitis lindigii (Mett.) Ching, Index Filic., Suppl. 3: 48. 1934.
Chrysodium lindigii Mett., Ann. Sci. Nat., Bot., sér. 5, 2: 205. 1864.
Habit/Habitat: Herb; terrestrial, in open forest on undulating terrain, except for baixios (waterlogged low-lying areas).
Material examined: BRAZIL. ACRE: Mâncio Lima, *G. T. Prance et al. 12069A* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10252* (NY).
Distribution: Mesoamerica and N South America.

Bolbitis nicotianifolia (Sw.) Alston, Bull. Misc. Inform. Kew 1932: 310. 1932.
Acrostichum nicotianifolium Sw., Syn. Fil. 13: 199. 1806.
Habit/Habitat: Herb; terrestrial, in open forest on undulating terrain, except for baixios (waterlogged low-lying areas).
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 9477* (NY), *W. R. Anderson 12122* (NY); Cruzeiro do Sul, *J. Prado et al. 1349* (HPZ); Manoel Urbano, *D. C. Daly et al. 9128* (NY), *D. C. Daly et al. 11413* (NY); Porto Valter, *P. J. M. Maas et al. P13292* (NY); Sena Madureira, *D. C. Daly et al. 8072* (NY).
Distribution: Antilles, Mesoamerica and N South America.

Bolbitis oligarchica (Baker) Henipp., Amer. Fern J. 65: 30. 1975.
Acrostichum oligarchicum Baker, Syn. Fil. 418. 1868.
Habit/Habitat: Herb; terrestrial, in forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, *M. Silveira et al. 1361* (NY).
Distribution: Mesoamerica and N South America.

Ctenitis refulgens (Klotzsch ex Mett.) Vareschi, Fl. Venezuela 1: 404. 1969.
Phegopteris refulgens Klotzsch ex Mett., Ann. Sci. Nat., Bot., sér. 5, 2: 240. 1864
Habit/Habitat: Herb; terrestrial, in forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1343* (HPZ, SP).
Distribution: Mexico, Mesoamerica and N South America.

Cyclodium guianense (Klotzsch) L. D. Gómez, Phytologia 60: 371. 1986.
Aspidium guianense Klotzsch, Linnaea 20: 364. 1847.
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1342* (HPZ, SP); Without locality, *J. Jangoux et al. 85-034* (NY).
Distribution: N South America.

Cyclodium meniscioides (Willd.) C. Presl, Tent. Pterid. 85. 1836.
Aspidium meniscioides Willd., Sp. Pl. 5: 218. 1810.
Infraspecific: var. ***meniscioides***
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1330* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1226* (HPZ, SP); *J. Prado et al. 1228* (HPZ, SP).
Distribution: N South America.

Didymochlaena truncatula (Sw.) J. Sm., J. Bot. (Hooker) 4: 196. 1841-1842 [1841].
Aspidium truncatulum Sw., J. Bot. (Schrader) 1800(2): 36. 1801.
Habit Habitat: Herb; terrestrial in primary forest, unudulating terrain, in places dissected by many small streams.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 9880* (HPZ, NY), *D. C. Daly et al. 11893* (NY); Cruzeiro do Sul, *G. T. Prance et al. 12087* (MG, NY), *G. T. Prance et al. 12377* (NY); Mâncio Lima, *D. G. Campbell et al. 8913* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America. Tropical Asia and Africa.

Dryopteris patula (Sw.) Underw., Native Ferns ed. 4 117. 1893.
Aspidium patulum Sw., Kongl. Vetensk. Acad. Handl. 1817(1): 64. 1817.
Habit Habitat: Herb; terrestrial in moist forest on Terra Firme, canopy discontinuous.
Material examined: BRAZIL. ACRE: Plácido de Castro, *C. Figueiredo & I. Riveiro 560* (NY); Sena Madureira, *D. C. Daly et al. 8117* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Elaphoglossum discolor (Kuhn) C. Chr., Index Filic. 306. 1905.
Acrostichum discolor Kuhn, Linnaea 36: 53. 1869.
Habit/Habitat: Herb; terrestrial or epipetric, in Campina.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 10607* (NY).

J. Prado et al. 1159 (HPZ, SP). *J. Prado et al. 1170* (HPZ, SP), *J. Prado et al. 1188* (HPZ, SP), *J. Prado et al. 1284* (HPZ, SP), *J. Prado et al. 1322* (HPZ, SP), *J. Prado et al. 1324* (HPZ, SP), *J. Prado et al. 1329* (HPZ), *J. Prado et al. 1388* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1223* (HPZ, SP).
Distribution: N South America.

Elaphoglossum flaccidum (Fée) T. Moore, Index Filic. 356. 1862.
Acrostichum flaccidum Fée, Mem. Foug. 2: 35, tab. 7, fig. 2. 1845.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Rodrigues Alves, *J. Prado et al. 1266* (HPZ, SP); Xapuri, *Silva et al.186* (CEN, SP).
Distribution: Antilles and N South America.

Elaphoglossum glabellum J. Sm., London J. Bot. 1: 197. 1842.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1297* (HPZ, SP).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, and N South America.

Elaphoglossum luridum (Fée) H. Christ, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss. 36(1): 33. 1899.
Acrostichum luridum Fée, Mem. Foug. 2: 35, tab. 19, fig. 1. 1845.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1152* (HPZ, SP), *J. Prado et al. 1174* (HPZ, SP), *J. Prado et al. 1198* (HPZ, SP), *J. Prado et al. 1310* (HPZ, SP), *J. Prado et al. 1327* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1219* (HPZ, SP), *J. Prado et al. 1220* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1238* (HPZ, SP), *J. Prado et al. 1241* (HPZ, SP), *J. Prado et al. 1260* (HPZ, SP), *J. Prado et al. 1281* (HPZ, SP).
Distribution: Antilles, Mesoamerica and N South America.

Elaphoglossum plumosum (Fée) T. Moore, Index Filic. 364. 1862.
Acrostichum plumosum Fée, Mem. Foug. 54, tab. 20, fig. 1. 1845.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1154* (HPZ, SP), *J. Prado et al. 1285* (HPZ); Mâncio Lima, *J. Prado et al. 1221* (HPZ, SP), *J. Prado et al. 1390* (HPZ, SP).
Distribution: N South America.

Elaphoglossum raywaense (Jenm.) Aslton, Bol. Soc. Brot., ser. 2, 32: 24. 1958.
Acrostichum raywaense Jenm., Ferns Brit. W. Ind. 341. 1909.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1314* (HPZ, SP); Mâncio Lima, *D. C. Daly et al. 8948* (HPZ, NY).
Distribution: N South America.

Elaphoglossum styriacum Mickel, Brittonia 39: 326, fig. 4I-K. 1987.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1381* (HPZ, SP).

Distribution: N South America.

Elaphoglossum tantalinum Mickel, Brittonia 39: 326, fig. 4I-K. 1987.
Habit/Habitat: Herb; epiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1179* (HPZ, SP), *J. Prado et al. 1321* (HPZ, SP), *J. Prado et al. 1384* (HPZ, SP).
Distribution: N South America.

Lastreopsis effusa (Sw.) Tindale, Victoria Naturalist 73: 184. 1957.
Polypodium effusum Sw., Prodr. 134. 1788.
Habit/Habitat: Herb; terrestrial, forested slope between Baixio and higher terrace.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11421* (NY).
Distribution: S Mexico, Antilles, Mesoamerica, and tropical South America.

Lomagramma guianensis (Aubl.) Ching, Amer. Fern J. 22: 17. 1932.
Polypodium guianense Aubl., Hist. Pl. Guiane 962. 1775.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 6757* (HPZ, NY), *D. C. Daly et al. 6786* (NY), *D. C. Daly et al. 11882* (NY); *M. Silveira et al. 1662* (NY); Cruzeiro do Sul, *J. Prado et al. 1292* (HPZ, SP); Mâncio Lima, *D. C. Daly et al. 11623* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7430* (HPZ, NY); Rodrigues Alves, *J. Prado et al. 1252* (HPZ, SP), *J. Prado et al. 1278* (HPZ, SP); Xapuri, *L. G. Lohmann & E. C. de Oliveira 590* (NY).
Distribution: Greater Antilles (except Jamaica) and tropical South America.

Polybotrya caudata Kunze, Linnaea 9: 23. 1834.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1295* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1143* (HPZ, SP), *J. Prado et al. 1145* (HPZ, SP) *G. T. Prance et al. 12069* (NY), *M. Silveira et al. 1662* (NY).
Distribution: S Mexico, Mesoamerica and N South America.

Polybotrya pubens Martius, Icon. Pl. Crypt. 87, tab. 25. 1834.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1205* (HPZ, SP), *J. Prado et al. 1207* (HPZ, SP), *J. Prado et al. 1394* (HPZ, SP).
Distribution: N South America.

Rumohra adiantiformis (G. Forst) Ching, Sinensia 5: 70. 1934.
Polypodium adiantiforme G. Forst, Prodr. 82. 1786.
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1157* (HPZ, SP), *J. Prado et al. 1181* (HPZ, SP), *J. Prado et al. 1287* (HPZ, SP).
Distribution: Bermuda, Antilles, N South America. Africa, Madagascar, New Zealand and Australia.

GLEICHENIACEAE
Gleichenella pectinata (Willd.) Ching, Sunyatsenia 5: 276. 1940.

Mertensia pectinata Willd., Kongl. Vetensk. Acad. Nya Handl. 25: 168, tab. 4. 1804.
Habit/Habitat: Herb; terrestrial along forest margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1189* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 12119* (MG, NY), *M. Silveira et al. 1348* (HPZ, NY).
Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Sticherus remotus (Kaul.) Chrysler, Amer. J. Bot. 31: 483. 1944.
Mertensia remota Kaulf., Enum. Filic. 39. 1824
Habit/Habitat: Herb; terrestrial along forest margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1300* (HPZ, SP).
Distribution: Mesoamerica and N South America.

HYMENOPHYLLACEAE
Didymoglossum krausii (Hook. & Grev.) C. Presl, Hymenophyllaceae 115. 1843.
Trichomanes krausii Hook. & Grev., Icon. Filic. 2: pl. 149. 1830
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 9115* (HPZ, NY).
Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

Didymoglossum ovale E. Fourn., Acta Bot. Neerl. 11: 296. 1962.
Habit/Habitat: Herb; epiphyte along river margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1288* (HPZ); Mâncio Lima, *J. Prado et al. 1230* (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Didymoglossum punctatum (Poir.) Desv., Mém. Soc. Linn. Paris. 6: 330. 1827.
Trichomanes punctatum Poir., Encycl. 8: 64. 1808.
Habit/Habitat: Herb; epiphyte.
Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, *D. C. Daly et al. 10330* (NY).
Distribution: Antilles, Mesoamerica and N South America.

Hymenophyllum angustum Bosch, Ned. Kruidk. Arch. 5(2): 183. 1861.
Habit/Habitat: Herb; epiphyte in waterlogged low-lying areas.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1153* (HPZ, SP).
Distribution: Amazonian Brazil.

Hymenophyllum polyanthos (Sw.) Sw., J. Bot. (Schrader) 1800(2): 102. 1801.
Trichomanes polyanthos Sw., Prodr. 137. 1788.
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1149* (HPZ, SP), *J. Prado et al. 1389* (HPZ, SP), *P. J. M. Maas et al. 12722* (NY); Mâncio Lima, *J. Prado et al. 1222* (HPZ, SP).
Distribution: Mexico, Mesoamerica and tropical South America.

Trichomanes ankersii C. Parker ex Hook. & Grev., Icon. Filic. 2(11): tab. 201. 1831.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 11854* (MG, NY), *J. Prado et al. 1150* (HPZ, SP), *J. Prado et al. 1158* (HPZ, SP), *J. Prado et al. 1168* (HPZ, SP), *J. Prado et al. 1214* (HPZ, SP), *J. Prado et al. 1312* (HPZ, SP), *J. Prado et al. 1387* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1236* (HPZ, SP), *J. Prado et al. 1257* (HPZ, SP).
Distribution: Mesoamerica and N South America.

Trichomanes bicorne Hook., Icon. Plan. 9: tab. 892. 1854.
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 10613* (NY), *J. Prado et al. 1147* (HPZ, SP), *J. Prado et al. 1176* (HPZ, SP), *J. Prado et al. 1268* (HPZ, SP), *J. Prado et al. 1323* (HPZ, SP), *J. Prado et al. 1271* (HPZ, SP).
Distribution: N South America.

Trichomanes crispum L., Sp. Pl. 2: 1097. 1753.
Habit/Habitat: Herb; terrestrial, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1313* (HPZ, SP), *J. Prado et al. 1380* (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica, and N South America

Trichomanes elegans Rich., Actes Soc. Hist. Nat. Paris 1: 114. 1792.
Habit/Habitat: Herb; terrestrial, in forest near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12225* (MG, NY), *J. Prado et al. 1212* (HPZ, SP); Mâncio Lima, *M. Silveira et al. 1247* (NY), *M. Silveira et al. 1250* (NY); Rodrigues Alves, *J. Prado et al. 1364* (HPZ, SP).
Distribution: Antilles, Mesoamerica, tropical and subtropical South America.

Trichomanes hostmannianum (Klotzsch) Kunze, Bot. Zeitung (Berlin) 5: 352. 1847.
Neurophyllum hostmannianum Klotzsch, Linnaea 18: 532. 1844.
Habit/Habitat: Herb; terrestrial, in forest near stream margins on wet soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1194* (HPZ, SP), *L. R. Marinho 217* (NY); Rodrigues Alves, *J. Prado et al. 1272* (HPZ, SP).
Distribution: N South America.

Trichomanes macilentum v. d. Bosch, Ned. Kruidk. Arch. 5(2): 146. 1861.
Habit/Habitat: Herb; terrestrial in waterlogged low-lying areas.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1385* (HPZ, SP).
Distribution: N South America.

Trichomanes martiusii C. Presl, Hymenophyllaceae 15, 36. 1843.
Habit/Habitat: Herb; terrestrial in forest on Terra Forme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1146* (HPZ, SP), *J. Prado et al. 1171* (HPZ, SP), *J. Prado et al. 1269* (HPZ, SP), *J. Prado et al. 1326* (HPZ, SP), *N. A. Rosa 657* (NY); Mâncio Lima, *J. Prado et al. 1217* (HPZ, SP).
Distribution: N South America.

Trichomanes pilosum Raddi, Opusc Sci. 3: 296. 1819.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1182* (HPZ, SP).
Distribution: Bolivia, Paraguay and Brazil (south of the Amazon Basin).

Trichomanes pinnatum Hedw., *s.l.*, Fil. Gen. Sp. tab. 4, fig. 1. 1799.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay and sand soils.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9608* (HPZ, NY); Cruzeiro do Sul, *J. Prado et al. 1183* (HPZ), *J. Prado et al. 1311* (HPZ, SP), *D. C. Daly et al. 11640* (NY); Mâncio Lima, *D. C. Daly et al.11589* (HPZ, NY), *G. T. Prance et al. 12178* (MG, NY); Porto Valter, *D. C. Daly et al. 7576* (HPZ, NY), *D. C. Daly et al. 11739* (NY), *P. J. M. Maas et al.13010* (MG, NY); Rodrigues Alves, *J. Prado et al. 1244* (HPZ); Sena Madureira, *G. T. Prance et al. 7730* (NY), *G. T. Prance et al. 7948* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.
Obs.: the material studied for this taxon cited above probably belong to more than two or three species, but more studies are necessary to clarify this situation.

Trichomanes tanaicum Hook. ex J. W. Sturm., Fl. Bras. 1(2): 260. 1859.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1209* (HPZ); Rodrigues Alves, *J. Prado et al. 1254* (HPZ, SP), *J. Prado et al. 1258* (HPZ).
Distribution: N South America.

Trichomanes trollii Bergdolt, Flora 127: 256, 264, fig. 3. 1933.
Habit/Habitat: Herb; terrestrial, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Rodrigues Alves, *J. Prado et al. 1366* (HPZ, SP).
Distribution: N South America.

Vandenboschia collariata (Bosch) Ebihara & K. Iwats., Blumea 51: 242. 2006.
Trichomanes collariatum Bosch, Ned. Kruidk. Arch. 4: 368. 1859 [1858].
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Without locality, *J. Jangoux et al. 85-053* (MG, NY), *J. Jangoux et al. 850-73* (MG, NY).
Distribution: Mexico, Mesoamerica and N South America.

LINDSAEACEAE
Lindsaea divaricata Klotzsch, Linnaea 18: 547. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1151* (HPZ, SP), *J. Prado et al. 1177* (HPZ, SP), *J. Prado et al. 1270* (HPZ, SP), *T. B. Croat & A. Rosas Jr. 62671* (NY); Rodrigues Alves, *J. Prado et al. 1359* (HPZ, SP).
Distribution: Mesoamerica and tropical South America.

Lindsaea hemiglossa Kramer, Acta Bot. Neerl. 6(2): 257. 1957.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on slopes.
Material examined: BRAZIL. ACRE: Mâncio Lima, *G. T. Prance et al. 12142* (NY).
Distribution: N South America.

Lindsaea lancea (L.) Bedd., Suppl. Ferns S. Ind. 6. 1876.
Adiantum lanceum L., Sp. Pl. ed. 2 1557. 1763.
Infraspecific: var. ***lancea***
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1309* (HPZ, SP).
Distribution: S Mexico, Antilles, Mesoamerica and tropical South America.

Infraspecific: var. ***falcata*** (Dryand.) Rosenst., Hedwigia 46: 79. 1906.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1148* (HPZ, SP), *J. Prado et al. 1167* (HPZ, SP), *J. Prado et al. 1308* (HPZ, SP), *J. Prado et al. 1309* (HPZ, SP).
Distribution: Mexico, Mesoamerica and N South America.

Lindsaea schomburgkii Klotzsch, Linnaea 18: 545. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1172* (HPZ, SP).
Distribution: N South America.

***Lindsaea* sp.**
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1348* (HPZ, SP).
Distribution: Peru and Brazil.

Lindsaea stricta (Sw.) Dryand. Trans. Linn. Soc. London 3: 42. 1797.
Adiantum strictum Sw., Prodr.: 135. 1788.
Infraspecific: var. ***stricta***
Habit/Habitat: Herb; terrestrial, in Campina.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 10633* (NY), *J. Prado et al. 1335* (HPZ, SP).
Distribution: Widespread in the Neotropics.

Lindsaea ulei Hieron., Hedwigia 44: 365. 1905.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1206* (HPZ, SP), *J. Prado et al. 1356* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1232* (HPZ, SP), *J. Prado et al. 1243* (HPZ, SP), *J. Prado et al. 1367* (HPZ), *J. Prado et al. 1369* (HPZ, SP).
Distribution: N South America.

LOMARIOPSIDACEAE
Cyclopeltis semicordata (Sw.) J. Sm., Bot. Mag. 72: 36. 1846.
Polypodium semicordatum Sw., Prodr. 132. 1788.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11721* (NY); Manoel Urbano, *D. C. Daly et al. 11427* (NY), *M. Silveira et al. 1574* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7342* (HPZ, NY), *D. C. Daly et al. 10473* (NY), *D. C. Daly et al. 10810* (NY); Porto Acre, *C. A. Cid & B. Nelson 2877* (NY), *P. J. M. Maas et al. 13247* (MG, NY); Quixadá, *C. A Cid & A. Rosas 2961* (NY); Reserva Extrativista

Chico Mendes, Colocação Simitumba, *A. R. S. Oliveira et al. 131* (HPZ, NY); Santa Rosa, *D. C. Daly et al. 11367* (NY); Santa Rosa, *D. C. Daly et al. 10978* (NY); Sena Madureira, *D. C. Daly et al. 7857* (HPZ, NY); Rio Branco, *D. C. Daly et al. 6881* (HPZ, NY); Tarauacá, *G. T. Prance et al. 7516* (NY), *D. C. Daly et al. 8667* (HPZ, NY), *D. C. Daly et al. 8799* (HPZ, NY); Xapuri, *D. C. Daly et al. 8420* (NY); Without locality, *J. Jangoux et al. 85-074* (MG, NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Lomariopsis japurensis (Mart.) J. Sm., Hist. Fil. 140. 1875.
Acrostichum japurense Mart., Icon. Pl. Crypt. 86, tab. 24. 1834.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9817* (HPZ, NY); Cruzeiro do Sul, *P. J. M. Maas et al. P12886* (NY); Mâncio Lima, *G. T. Prance et al. 12055* (NY); Marechal Thaumaturgo, *L. G. Lohmann et al. 480* (NY); Santa Rosa, *D. C. Daly et al. 9945* (NY).
Distribution: Mesoamerica and N South America.

Lomariopsis nigropaleata Holttum, Bull. Misc. Inform. Kew 1939: 618. 1940.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Brasiléia, *S. R. Lowrie et al. 726* (NY); Cruzeiro do Sul, *J. Prado et al. 1202* (HPZ, SP), *J. Prado et al. 1211* (HPZ, SP), *J. Prado et al. 1352* (HPZ, SP); Mâncio Lima, *D. C. Daly et al. 11568* (NY); Marechal Thaumaturgo, *L. C. Ming & L. A. Ferreira 324* (NY).
Distribution: N South America.

Lomariopsis prieuriana Fée, Mem. Foug. 2: 66, pl. 25, fig. 1. 1845.
Habit/Habitat: Herb; hemiepiphyte, in Terra Firme forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, *J. Prado et al. 1137* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1363* (HPZ, SP).
Distribution: Mesoamerica and N South America.

Nephrolepis biserrata (Sw.) Schott, Gen. Fil. pl. 3. 1834.
Aspidium biserratum Sw., J. Bot. (Schrader) 1800(2): 32. 1801.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1163* (HPZ, SP), *J. Prado et al. 1180* (HPZ, SP), *J. Prado et al. 1199* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1216* (HPZ, SP).
Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

Nephrolepis brownii (Desv.) Hovenkamp & Miyam., Blumea 50: 293. 2005.
Nephrodium brownii Desv., Mem. Soc. Linn. Paris 6: 252. 1827.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *P. Delprete et al. 8111* (NY); Mâncio Lima, *D. C. Daly et al. 11595* (NY).
Distribution: Florida, S Mexico, Antilles, Mesoamerica, tropical South America, Paleotropics.

Nephrolepis pendula (Raddi) J. Sm., J. Bot. (Hooker) 4: 197. 1841-1842 [1841].
Aspidium pendulum Raddi Opusc. Sci. 3: 289. 1819.
Habit/Habitat: Herb; epiphyte on Terra Firme.
Material examined: BRAZIL. ACRE: Tarauacá, *G. T. Prance et al. 7296* (NY).
Distribution: S Mexico, Mesoamerica and N South America.

Nephrolepis rivularis (Vahl) Mett. ex Krug, Bot. Jahrb. Syst. 24: 122. 1897.
Polypodium rivulare Vahl, Eclog. Amer. 3: 51. 1807.
Habit/Habitat: Herb; epiphyte on Várzea forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1286* (HPZ, SP), *J. Prado et al. 1325* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 12179* (MG, NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

LYCOPODIACEAE
Huperzia dichotoma (Jacq.) Trevisan, Atti Soc. Ital. Sci. Nat. 17: 248. 1874.
Lycopodium dichotomum Jacq., Enum. Stirp. Vindob. 314. 1762.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Without locality, *M. Silveira s.n.* (HPZ).
Distribution: Florida, Mexico, Antilles, Mesoamerica and N South America.

Lycopodiella cernua (L.) Pic.Serm., Webbia 23: 166. 1968.
Lycopodium cernuum L., Sp. Pl. 2: 1103. 1753
Habit/Habitat: Herb; terrestrial on sandy soils in open places.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1160* (HPZ, SP), *J. Prado et al. 1191* (HPZ, SP), *J. Prado et al. 1331* (HPZ), *A. Rosas et al. 313* (NY), *D. C. Daly et al. 10599* (NY), *D. C. Daly et al. 10683* (NY), *G. T. Prance et al. 12525* (MG, NY), *L. R. Marinho 64* (NY), *L. R. Marinho 212* (NY), *P. Delprete et al. 8063* (NY).
Distribution: Pantropical.

LYGODIACEAE
Lygodium venustum Sw., J. Bot. (Schrader) 1801(2): 303. 1803.
Habit/Habitat: Herb; vine-like, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Manoel Urbano, *M. Silveira et al. 1543* (HPZ, NY); Rio Branco, *L. Coêlho & A. Rosas 1925* (NY); Tarauacá, *C. Ehringhaus et al. 346* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Lygodium volubile Sw., J. Bot. (Schrader) 1801(2): 303. 1803.
Habit/Habitat: Herb; vine-like, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1371* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

MARATTIACEAE
Danaea leprieurii Kunze, Mém. Acad. Roy. Sci. (Turin) 5(1790-1791): 429 tab. 9. 1793.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1204* (HPZ, SP).

Distribution: S Mexico, Antilles, Mesoamerica, and N South America.

Danaea nodosa (L.) Sm., Mem. Acad. Roy. Sci. (Turin) 5(1790-1791): 420, tab. 9, fig. 11. 1793.
Achrostichum nodosum L., Sp. Pl. 2: 1070. 1753.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 6787* (HPZ, NY), *D. C. Daly et al. 9884* (HPZ, NY); Feijó, *P. Delprete et al. 8301A & B* (NY); Sena Madureira, *D. C. Daly et al. 8137* (HPZ, NY); Without locality, *J. Jangoux et al. 85-071* (NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

Danaea trifoliata Reichenb. ex Kunze, Analecta Pteridogr. 4, tab. 2. 1837.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins.
Material examined: BRAZIL. ACRE: Rodrigues Alves, *J. Prado et al. 1365* (HPZ, SP).
Distribution: Guianas and Brazil.

METAXYACEAE
Metaxya rostrata (Kunth) C. Presl, Tent. Pterid. 60, tab. 1, fig. 5. 1836.
Aspidium rostratum Kuhn, Nov. Gen. Sp. (quarto ed.) 1: 12. 1815 [1816].
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11705* (NY), *J. Prado et al. 1186* (HPZ, SP), *J. Prado et al. 1301* (HPZ, SP), *J. Prado et al. 1320* (HPZ, SP); Mâncio Lima, *D. C. Daly et al. 11624* (NY), *M. Silveira et al. 1365* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10526* (NY); Porto Valter, *D. C. Daly et al. 7577* (NY), *P. J. M. Maas et al. P13150* (NY); Without locality, *J. Jangoux et al. 85-043* (NY), *J. Jangoux et al. 85-108* (NY).
Distribution: S Mexico, Lesser Antilles, Mesoamerica and N South America.

POLYPODIACEAE
Campyloneurum abruptum (Lindm.) B. Léon, Fieldiana, Bot., n.s. 32: 172. 1993.
Polypodium repens var. *abruptum* Lindm., Ark. Bot. 1: 245. 1903.
Habit/Habitat: Herb; epiphyte, Várzea forest.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11225* (NY), *M. Silveira et al. 1582* (NY).
Distribution: N South America.

Campyloneurum angustifolium (Sw.) Fée, Mem. Foug. 5: 257. 1852.
Polypodium angustifolium Sw., Prodr. 130. 1788.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Bujari, *M. de Pardo et al. 93* (NY); Cruzeiro do Sul, *G. T. Prance et al. 12617* (NY), *L. R. Marinho 163* (NY); Feijó, *P. Delprete et al. 8311* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10936* (NY); Porto Valter, *P. J. M. Maas et al. 12931* (NY); Tarauacá, *D. C. Daly et al. 8628* (HPZ, NY), *G. T. Prance et al. 7384* (NY), *G. T. Prance et al. 7249* (NY), *M. Silveira et al. 1146* (NY).
Distribution: S Mexico, Lesser Antilles, Mesoamerica and tropical South America.

Campyloneurum aphanophlebium (Kunze) T. Moore, Index Filic. 223. 1861.
Polypodium aphanophlebium Kunze, Bot. Zeitung (Berlin) 3(17): 288. 1845.
Habit/Habitat: Herb; epiphyte, forest in broad, meandering stream vally in steeply hilly terrain.
Material examined: BRAZIL. ACRE: Brasiléia, *G. P. da Silva et al. 173* (NY); Mâncio Lima, *D. C. Daly et al. 11601* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7496* (HPZ, NY), *D. C. Daly et al. 10255* (NY); Porto Valter, *P. J. M. Maas et al. P13181* (NY); Rodrigues Alves, *J. Prado et al. 1261* (HPZ, SP); Santa Rosa, *D. C. Daly et al. 10173* (NY); Tarauacá, *D. C. Daly et al. 8630* (HPZ, NY), *G. T. Prance et al. 7267* (NY).
Distribution: Mesoamerica and N South America.

Campyloneurum fuscosquamatum Lellinger, Amer. Fern J. 78: 21, fig. 4, 10. 1988.
Habit/Habitat: Herb; epiphyte on Terra Firme forest and Várzea forest.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 6802* (HPZ, NY), *D. C. Daly et al. 11894* (NY); Bujari, *W. R. Anderson 12123* (NY); Feijó, *P. Delprete et al. 8580* (NY); Mâncio Lima, *G. T. Prance et al. 12052* (MG, NY), *G. T. Prance et al. 12052A* (NY); Quixadá, *E. Forero et al. 6388* (MG, NY); Santa Rosa, *D. C. Daly et al. 10151* (NY), *D. C. Daly et al. 10994* (NY); Sena Madureira, *D. C. Daly et al. 7856* (HPZ, NY), *G. T. Prance et al. 7694* (NY); Tarauacá, *D. C. Daly et al. 8620* (HPZ, NY), *D. C. Daly et al. 8760* (HPZ, NY); Without locality, *J. Jangoux et al. 85-039* (MG, NY).
Distribution: N South America.

Campyloneurum ophiocaulon (Klotzsch) Fée, Mem. Foug. 258. 1852.
Polypodium ophiocaulon Klotzsch, Linnaea 20: 401. 1847.
Habit/Habitat: unknown.
Material examined: BRAZIL. ACRE: Bujari, *M. de Pardo et al. 94* (NY).
Distribution: N South America.

Campyloneurum phyllitidis (L.) C. Presl, Tent. Pterid. 190. 1836.
Polypodium phyllitidis L., Sp. Pl. 2: 1083. 1753.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 11922* (NY); Cruzeiro do Sul, *D. C. Daly et al. 11716* (NY), *J. Prado et al. 1315* (HPZ, SP), *J. Prado et al. 1377* (HPZ, SP), *G. T. Prance et al. 2783* (NY), *G. T. Prance et al. 2818* (NY), *G. T. Prance et al. 12530* (NY), *G. T. Prance et al. 12622* (MG, NY); Feijó, *G. T. Prance et al. 7317* (NY); Mâncio Lima, *J. Prado et al. 1136* (HPZ, SP), *J. Prado et al. 1142* (HPZ, SP), *J. Prado et al. 1215* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 9129* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10528* (NY); Porto Acre, *A. R. S. Oliveira et al. 763* (NY); Porto Valter, *P. J. M. Maas et al. P12932* (MG, NY); Rodrigues Alves, *J. Prado et al. 1264* (HPZ, SP), *J. Prado et al. 1280* (HPZ, SP); Sena Madureira, *D. C. Daly et al. 7906* (HPZ, NY); Without locality, *J. Jangoux et al. 85-098* (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Campyloneurum repens (Aubl.) C. Presl, Tent. Pterid. 190. 1836.
Polypodium repens Aubl., Hist. Pl. Guiane 2: 962. 1775.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1338* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1273* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Campyloneurum sphenodes (Klotzsch) Fée, Mem. Foug. 5: 258. 1852.
Polypodium sphenodes Klotzsch, Linnaea 20: 402. 1847.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1290* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1141* (HPZ, SP); Marechal Thaumaturgo, *D. C. Daly et al. 10345* (NY); Porto Valter, *D. C. Daly et al. 7556* (NY).
Distribution: Mesoamerica and N South America.

Dicranoglossum desvauxii (Klotzsch) Proctor, Rhodora 63: 35. 1961.
Taenitis desvauxii Klotzsch, Linnaea 20: 431. 1847.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 9466* (NY); Cruzeiro do Sul, *J. Prado et al. 1213* (HPZ), *J. Prado et al. 1393* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 12247* (NY); Rodrigues Alves, *J. Prado et al. 1239* (HPZ, SP), *J. Prado et al. 1251* (HPZ); Without locality, *J. Jangoux et al. 85-113* (NY).
Distribution: Lesser Antilles, tropical South America.

Microgramma baldwinii Brade, Arch. Jard. Bot. Rio de Janeiro 18: 30, tab. 1. 1965.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme, near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *N. A. Rosa 716* (NY), *G. T. Prance et al. 12515* (MG, NY), *J. Prado et al. 1353* (HPZ, SP); Mâncio Lima, *M. Silveira et al. 1366* (NY); Rodrigues Alves, *J. Prado et al. 1235* (HPZ), *J. Prado et al. 1267* (HPZ, SP), *J. Prado et al. 1282* (HPZ), *J. Prado et al. 1368* (HPZ).
Distribution: N South America.

Microgramma bifrons (Hook.) Lellinger., Amer. Fern J. 67: 59. 1977.
Polypodium bifrons Hook., Fil. Exot. 1859.
Habit/Habitat: Herb; epiphyte, in open forest.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8998* (HPZ, NY).
Distribution: Mesoamerica and N South America.
Obs: This species has long been called *Solanopteris bifrons* (Hook.) Copel.

Microgramma dictyophylla (Kunze ex Mett.) de la Sota, Novon 17: 27. 2007.
Polypodium dictyophyllum Kunze ex Mett.., Abh. Senckenberg Naturf. Ges. 2: 96. 1856.
Habit/Habitat: Herb; epiphyte, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8955* (HPZ, NY), *D. G. Campbell et al. 8932* (NY); Tarauacá, *G. T. Prance et al. 7258* (MG, NY); Without locality, *J. Jangoux et al. 85-094* (MG, NY).
Distribution: Mesoamerica and N South America.
Obs: This species has long been called *Microgramma fuscopunctata* (Hook.) Vareschi.

Microgramma megalophylla (Desv.) de la Sota, Bol. Soc. Argent. Bot. 10: 158. 1963.
Polypodium megalophyllum Desv., Mem. Soc. Linn. Paris 6: 227. 1827.

Habit/Habitat: Herb; epiphyte, in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12595* (MG, NY), *J. Prado et al. 1196* (HPZ, SP), *J. Pruski et al. 3465* (NY), *P. J. M. Maas et al. P12725* (MG, NY); Mâncio Lima, *M. Silveira et al. 1307* (NY); Rodrigues Alves, *J. Prado et al. 1265* (HPZ, SP); Without locality, *J. Jangoux et al. 85-015* (NY).
Distribution: N South America.

Microgramma percussa (Cav.) de la Sota, Physis (Buenos Aires) 44(106C): 28. 1986.
Polypodium percussum Cav., Descr. Pl. 243. 1802.
Habit/Habitat: Herb; epiphyte, Terra Firme forest on gently undulating terrain, undistributed but canopy open.
Material examined: BRAZIL. ACRE: Bujari, *M. de Pardo et al. 92* (HPZ, NY); Cruzeiro do Sul, *D. C. Daly et al. 11714* (NY), *D. C. Daly et al. 11657* (NY), *J. Prado et al. 1346* (HPZ), *J. Prado et al. 1375* (HPZ), *P. J. M. Maas et al. P13133B* (NY); Feijó, *P. Delprete et al. 8310* (NY), *P. Delprete et al. 8488* (NY); Manoel Urbano, *D. C. Daly et al. 11218* (NY), *D. C. Daly et al. 11420* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10297* (NY), *L. G. Lohmann et al. 458* (NY); Sena Madureira, *M. Silveira et al. 616* (HPZ, NY); Tarauacá, *C. Ehringhaus et al. 382* (NY), *G. T. Prance et al. 7380* (NY).
Distribution: S Mexico, Mesoamerica and tropical South America.

Microgramma persicariifolia (Schrad.) C. Presl, Tent. Pterid. 214. 1836.
Polypodium persicariifolium Schrad., Gott. gel. Anz. 1824: 867. 1824.
Habit/Habitat: Herb; epiphyte in Várzea forest.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 8497* (HPZ, NY); Cruzeiro do Sul, *D. C. Daly et al. 7300* (HPZ, NY); Mâncio Lima, *G. T. Prance et al. 12061* (NY); Santa Rosa, *D. C. Daly et al. 10103* (NY), *D. C. Daly et al. 11340* (NY); Sena Madureira, *A. R. S. Oliveira et al. 622* (NY), *M. de Pardo et al. 148* (HPZ, NY); Xapuri, *L. G. Lohmann et al. 600* (NY); Without locality, *D. G. da Silva et al. 57* (NY).
Distribution: Costa Rica, Panama and tropical South America.

Microgramma reptans (Cav.) A. R. Sm., Proc. Calif. Acad. Sci., ser. 4, 40(8): 230. 1975.
Acrostichum reptans Cav., Anales Hist. Nat. 1: 104. 1799.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Bujari, *M. de Pardo et al. 100* (NY); Cruzeiro do Sul, *D. C. Daly et al. 11813* (NY); Manoel Urbano, *D. C. Daly et al. 11252* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10571* (NY); Porto Acre, *A. R. S. Oliveira et al. 744* (NY); Porto Valter, *P. J. M. Maas et al. 13057* (NY); Sena Madureira, *D. C. Daly et al. 8081* (HPZ, NY).
Distribution: Mexico, Cuba, Mesoamerica and tropical South America.

Microgramma tecta (Kaulf.) Alston, J. Wash. Acad. Sci. 48: 232. 1958.
Polypodium tectum Kaulf., Enum. Fil. 87. 1824.
Habit/Habitat: Herb; epiphyte in forest near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1296* (HPZ, SP), *J. Prado et al. 1372* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1274* (HPZ, SP).
Distribution: Guianas and Brazil.

Microgramma thurnii (Baker) R. M. Tryon & Stolze, Fieldiana, Bot., n.s. 32: 156. 1993.
Polypodium thurnii Baker, Ann. Bot. (Oxford) 5: 476. 1891.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1299* (HPZ, SP), *J. Prado et al. 1328* (HPZ, SP), *J. Prado et al. 1357* (HPZ, SP), *J. Prado et al. 1373* (HPZ, SP), *J. Prado et al. 1383* (HPZ, SP), *P. Delprete et al. 8092* (NY); Mâncio Lima, *J. Prado et al. 1218* (HPZ, SP); Porto Valter, *D. C. Daly et al. 11789* (NY), *P. J. M. Maas et al. 13133A* (NY); Rodrigues Alves, *J. Prado et al. 1250* (HPZ); Without locality, *J. Jangoux et al. 85-035* (NY).
Distribution: N South America.

Niphidium crassifolium (L.) Lellinger, Amer. Fern J. 62: 106. 1972.
Polypodium crassifolium L., Sp. Pl. 2: 1083. 1753.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 11889* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10246* (NY); Rodrigues Alves, *J. Prado et al. 1263* (HPZ, SP), *J. Prado et al. 1283* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Pecluma hygrometrica (Splitg.) M. G. Price, Amer. Fern J. 73: 115. 1983.
Polypodium hygrometricum Splitg., Tijdschr. Natuurl. Gesch. Physiol. 7: 409. 1840.
Habit/Habitat: Herb; epiphyte in open forest on Terra Firme with palms, undulating terrain.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7488* (NY); Santa Rosa, *D. C. Daly et al. 10176* (NY), *D. C. Daly et al. 10988* (NY).
Distribution: S Mexico, Mesoamerica and N South America.

Pecluma pectinata (L.) M.G. Price, Amer. Fern J. 73: 115. 1983.
Polypodium pectinatum L., Sp. Pl. 2: 1085-1086. 1753.
Habit/Habitat: Herb; epiphyte in Várzea forest.
Material examined: BRAZIL. ACRE: Bujari, *M. de Pardo et al. 95* (NY); Cruzeiro do Sul, *G.T. Prance et al. 2784* (NY).
Distribution: Antilles, Mesoamerica and tropical South America.

Pecluma pilosa (A. M. Evans) M. Kessler & A. R. Sm. Candollea 60: 281. 2005.
Polypodium ptilodon Kunze var. *pilosum* A. M. Evans, Ann. Missouri Bot. Gard. 55: 259, fig. 20. 1969.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8945* (HPZ, NY), *G. T. Prance et al. 12282* (NY).
Distribution: N South America.

Pecluma plumula (Willd.) M. G. Price, Amer. Fern J. 73: 115. 1983.
Polypodium plumula Willd., Sp. Pl. 5: 178. 1810.
Habit/Habitat: Herb; epiphyte, in riverside vegetation.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11546* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10530* (NY); Quixadá, *E. Forero et al. 6347*

(NY); Rio Branco, *D. C. Daly et al. 6923* (NY); Santa Rosa, *D. C. Daly et al. 11057* (NY); Sena Madureira, *D. C. Daly et al. 7907* (NY); Tarauacá, *G. T. Prance et al. 7248* (NY); *G. T. Prance et al. 7385* (MG, NY).
Distribution: Florida, Mexico, Antilles, Mesoamerica, tropical South America.

Phlebodium decumanum (Willd.) J. Sm., J. Bot. (Hooker) 4: 59. 1841.
Polypodium decumanum Willd., Sp. Pl. 5: 170. 1810.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11209* (NY); Porto Valter, *P. J. M. Maas et al. P13299* (NY); Rio Branco, *C. A. Cid & A. Souza 2986* (NY), *D. C. Daly et al. 6871* (HPZ, NY); Santa Rosa, *D. C. Daly et al. 10119* (NY), *D. C. Daly et al. 11272* (NY); Sena Madureira, *D. C. Daly et al. 8096* (HPZ, NY); Tarauacá, *P. Delprete et al. 8257* (NY); Xapuri, *D. C. Daly et al. 8414* (NY).
Distribution: S Florida, Antilles, Mesoamrica, tropical and subtropical South America.

Pleopeltis bombycina (Maxon) A. R. Sm., Candollea 60: 281. 2005.
Polypodium bombycinum Maxon, Contr. U.S. Natl. Herb. 17(7): 592. 1916.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 11894* (NY), *G. T. Prance et al. 11927* (NY), *G. T. Prance et al. 12529* (NY), *J. Prado et al. 1392* (HPZ, SP), *D. C. Daly et al. 11656* (NY); Mâncio Lima, *G. T. Prance et al. 12040* (MG, NY); Rio Branco, *D. C. Daly et al. 6868* (NY), *E. Forero et al. 6346* (NY); Rodrigues Alves, *J. Prado et al. 1234* (HPZ, SP).
Distribution: Mesoamerica and N South America.

Pleopeltis polypodioides (L.) E. G. Andrews & Windham, Contr. Michigan Herb. 19: 46. 1993.
Acrostichum polypodioides L., Sp. Pl. 2: 1068. 1753.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9813* (HPZ, NY); Manoel Urbano, *D. C. Daly et al. 9081* (NY), *D. C. Daly et al. 11219* (NY), *D. C. Daly et al. 11562* (NY); Rio Branco, *B. Nelson 737* (MG, NY), *D. C. Daly et al. 9516* (HPZ, NY), *D. C. Daly et al. 9526* (HPZ, NY), *C. A. Cid 2893* (MG, NY); Sena Madureira, *D. C. Daly et al. 7908* (HPZ, NY).
Distribution: Antilles, Mesoamerica, tropical South America.

Serpocaulon caceresii (Sodiro) A. R. Sm., Taxon 55: 928, fig. 3A. 2006.
Polypodium caceresii Sodiro, Crypt. Vasc. Quit. 360. 1893.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1210* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 12141* (NY), *M. Silveira et al. 1244* (NY); Rodrigues Alves, *J. Prado et al. 1253* (HPZ, SP); Santa Rosa, *D. C. Daly et al. 10169* (NY); Without locality, *J. Jangoux et al. 85-037* (NY).
Distribution: N South America.

Serpocaulon triseriale (Sw.) A. R. Sm., Taxon 55: 929, figs. 3F, 4L-O. 2006.
Polypodium triseriale Sw., J. Bot. (Schrader) 2: 26. 1800 [1801].
Habit/Habitat: Herb; epiphyte, in open forest.

Material examined: BRAZIL. ACRE: Mâncio Lima, *D. C. Daly et al. 8944* (HPZ, NY).
Distribution: S Mexico, Antilles, Mesoamerica and N South America.

PSILOTACEAE

Psilotum nudum (L.) P. Beauv., Prodr. Aetheogam.: 106, 112. 1805.
Lycopodium nudum L., Sp. Pl. 2: 1100. 1753.
Habit/Habitat: Herb; epiphyte, in open forest.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 9693* (NY); Rio Branco, *D. C. Daly et al. 6669* (HPZ, NY); Sena Madureira, *B. Nelson 614* (NY), *G.T. Prance et al. 7956* (NY); Xapuri, *C. Figueiredo 211* (HPZ, NY), *D. C. Daly et al. 8430* (HPZ, NY); Without locality, *J. M. Pires et al. 10058* (NY).
Distribution: Cosmopolitan.

PTERIDACEAE

Adiantum argutum Splitg., Tijdschr. Natuurl. Gesch. Physiol. 7: 427, fig. 1-2. 1840.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Bôca do Acre, *G. T. Prance et al. 2533* (MG, NY); Cruzeiro do Sul, *J. Prado et al. 1344* (HPZ, SP); Porto Acre, *D. C. Daly et al. 7990* (HPZ); Rio Branco, *D. C. Daly et al. 6675* (NY), *S. R. Lowrie et al. 650* (GH, NY, R, RB, US); Sena Madureira, *M. Silveira et al. 668* (NY), *T. B. Croat & A. Rosas Jr. 62716* (HPZ); Xapurri, *K. A. Kainer et al. 126* (NY), *L. C. Ming et al. 356* (HPZ), *M. Pinard 809* (NY), *D. C. Daly et al. 7261* (HPZ, NY).
Distribution: Guianas and Brazil.

Adiantum cajennense Willd. ex Klotzsch, Linnaea 18: 552. 1845.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme on gently undulating terrain, undistributed but canopy open.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11658* (NY), *D. C. Daly et al. 11704* (NY), *J. Prado et al. 1201* (HPZ, SP), *J. Prado et al. 1293* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1140* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1233* (HPZ), *J. Prado et al. 1245* (HPZ).
Distribution: Guianas and Brazil.

Adiantum decoratum Maxon & Weath., Amer. J. Bot. 19: 165. 1932.
Habit/Habitat: Herb; terrestrial, forest in broad, meandering stream vally in steeply hilly terrain.
Material examined: BRAZIL. ACRE: Santa Rosa, *D. C. Daly et al. 10164* (NY), *D. C. Daly et al. 11365* (NY).
Distribution: Mexico, Mesoamerica, N South America.

Adiantum diogoanum Glaz. ex Baker, J. Bot. 20: 310. 1882.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 9385* (NY).
Distribution: South America.

Adiantum dolosum Kunze, Linnaea 21: 219. 1848.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Rodrigues Alves, *J. Prado et al. 1249* (HPZ, SP).

Distribution: South America.

Adiantum humile Kunze, Linnaea 9: 80. 1834.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1302* (HPZ, SP), *J. Prado et al. 1339* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1246* (HPZ, SP).
Distribution: Belize and tropical South America.

Adiantum latifolium Lam., Encycl. 1: 43. 1783.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *Croat & Rosas 62393A* (MO, UC); *J. Prado et al. 1294* (HPZ, SP); *J. Prado et al. 1374* (HPZ, SP), *T. B. Croat & A. Rosas Jr. 62393A* (HPZ); Manoel Urbano, *D. C. Daly et al. 9149* (NY). Tarauacá, 23 set. 1968, *Prance et al. 7495* (GH, K, NY, R, UC, US).
Distribution: Mexico, Antilles, Mesoamerica and South America.

Adiantum multisorum Samp., Relat. Commiss. Linhas. Estrateg. Matto Grosso Amazonas 5(Bot. pt. 7): 11, pl. 1, fig. 1. 1916.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1358* (HPZ, SP).
Distribution: N South America.

Adiantum nudum A. R. Sm., Ann. Missouri Bot. Gard. 77: 260, fig. 6A-B. 1990.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *W. C. Steward et al. P12679* (NY); Mâncio Lima, *D. C. Daly et al. 8854* (NY).
Distribution: N South America.

Adiantum obliquum Willd., Sp. Pl. 5(1): 429. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1345* (HPZ, SP), *J. Jangoux et al. 85-008* (NY); Rodrigues Alves, *J. Prado et al. 1259* (HPZ); *J. Prado et al. 1360* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Adiantum pectinatum Kunze ex Baker, Syn. Fil. 120. 1867.
Habit/Habitat: Herb; terrestrial, riverside vegetation.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11474* (NY).
Distribution: Mesoamerica and tropical South America.

Adiantum petiolatum Desv., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck. Gesammten Naturk. 5: 326. 1811.
Habit/Habitat: Herb; terrestrial, riverside vegetation.
Material examined: BRAZIL. ACRE: Basin of Rio Juruá, Rio Juruá Mirim and Igarapé Periquito (right-bank tributary), across from Santo Antônio, *D. C. Daly et al. 11708* (NY); Mâncio Lima, *J. Prado et al. 1139* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 11528* (NY); Rodrigues Alves, *J. Prado et al. 1275* (HPZ, SP).

Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Adiantum poeppigianum (Kuhn) Hieron., Hedwigia 48: 231. 1909.
Adiantum lucidum var. *poeppigianum* Kuhn, Bot. Jahrb. Syst. 1: 340. 1881.
Habit/Habitat: Herb; terrestrial in forest on steep slopes.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9810* (HPZ, NY); Manoel Urbano, *D. C. Daly et al. 11473* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10950* (NY); Sena Madureira, *D. C. Daly et al. 7972* (NY); Santa Rosa, *D. C. Daly et al. 10034* (NY).
Distribution: South America.

Adiantum pulverulentum L., Sp. Pl. 2: 1096. 1753.
Habit/Habitat: Herb; terrestrial in primary forest in low-lying area (Baixio) shallowly dissected by many small streams.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7365* (HPZ, NY), *G. T. Prance et al. 12065* (K, NY), *G. T. Prance et al. 12065a* (NY), *W. C. Steward et al. P12894* (K, NY), *J. Prado et al. 1347* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 9173* (NY), *D. C. Daly et al. 11392* (NY); Rio Azul, *J. Jangoux et al. 85-064* (NY); Rio Branco, *S. R. Lowrie et al. 649* (GH, NY, R, US); Tarauacá, *C. Figueiredo et al. 883* (NY); Santa Rosa, *D. C. Daly et al. 10050* (NY), *D. C. Daly et al. 11004* (NY) Rio Juruá between Mundurucus & Tatajuba, *Maas et al. P12894* (GH, K, NY, R, US).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Adiantum scalare R. M. Tryon, Amer. Fern J. 47: 141, tab. 15. 1957.
Habit/Habitat: Herb; terrestrial in moist forest on Terra Firme, tertiary sediments, undulating terrain.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7331* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10304* (NY); Tarauacá, *G. T. Prance et al. 7335* (K, NY).
Distribution: N South America.

Adiantum terminatum Kunze ex Miq., Verslagen Meded. Vier Kl. Kon. Ned. Inst. Wetensch. Letterk. Schoone Kunsten 1842: 187. 1843.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Jangoux et al. 85-009* (NY), *J. Prado et al. 1303* (HPZ, SP), *J. Prado et al. 1354* (HPZ, SP), *G. T. Prance et al. 12203* (INPA, MO, NY); Porto Valter, *D. C. Daly et al. 11786* (NY), *D. C. Daly et al. 11788* (NY); Rodrigues Alves, *J. Prado et al. 1361* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Adiantum tetraphyllum Willd., Sp. Pl. 5(1): 441. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 11878* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Adiantum tomentosum Klotzsch, Linnaea 18: 553. 1844.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance 11390* (MG, NY).

J. Prado et al. 1165 (HPZ, SP), *J. Prado et al. 1195* (HPZ, SP), *P. J. M. Maas et al. P12791* (NY); *P. G. Windisch 2574* (HB, HRCB); Porto Valter, *D. C. Daly et al. 7578* (HPZ, NY); Rodrigues Alves, *J. Prado et al. 1242* (HPZ).
Distribution: Tropical South America.

Adiantum windischii J. Prado, Kew Bull. 60: 119-121, fig. 2. 2005.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. P13045* (UC); Rodrigues Alves, *J. Prado et al. 1276* (HPZ, SP).
Distribution: Tropical South America.

Ananthacorus angustifolius (Sw.) Underw. & Maxon, Contr. U.S. Natl. Herb. 10: 487. 1908.
Pteris angustifolia Sw., Prodr. 129. 1788.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 9336* (NY); Cruzeiro do Sul, *D. C. Daly et al. 7495* (HPZ, NY), *G. T. Prance et al. 12616* (MG, NY); Rio Branco, *B. Nelson 739* (MG, NY); Santa Rosa, *D. C. Daly et al. 10160* (NY); Sena Madureira, *M. Silveira et al. 615* (HPZ, NY); Tarauacá, *D. C. Daly et al. 8737* (HPZ, NY), *G.T. Prance et al. 7379* (MG, NY).
Distribution: Mexico, Antilles and N South America.

Anetium citrifolium (L.) Splitg., Tijdschr. Natuurl. Gesch. Physiol. 7: 395. 1840.
Acrostichum citrifolium L., Sp. Pl. 2: 1067. 1753.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Tarauacá, *D. C. Daly et al. 8269* (NY), *G. T. Prance et al. 7426* (MG, NY).
Distribution: Mexico, Mesoamerica and tropical South America.

Hecistopteris pumila (Spreng.) Benedict, London J. Bot. 1: 193. 1842.
Gymnogramma pumila Spreng., Tent. Suppl. 31. 1828.
Habit/Habitat: Herb; epiphyte on the base of trunks in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1208* (HPZ), *J. Prado et al. 1336* (HPZ, SP), *J. Prado et al. 1386* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Pityrogramma calomelanos (L.) Link, Handbuch 3: 20. 1833.
Acrostichum calomelanos L., Sp. Pl. 2: 1072. 1753.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near river margins on clay soils.
Material examined: BRAZIL. ACRE: Brasiléia, *S. R. Lowrie et al. 696* (NY); Cruzeiro do Sul, *J. Prado et al. 1173* (HPZ, SP), *J. Prado et al. 1304* (HPZ, SP); Assis Brasil, *D. C. Daly et al. 9634* (HPZ, NY); Mâncio Lima, *M. Silveira et al. 1294* (NY); Quixadá, *E. Forero et al. 6381* (NY); Sena Madureira, *M. Silveira et al. 670* (HPZ, NY); Tarauacá, *G. T. Prance et al. 7302A* (NY), *M. Silveira et al. 868* (NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica and tropical South America.

Polytaenium cajenense (Desv.) Benedict, Bull. Torrey Bot. Club 38: 169. 1911.
Hemionitis cajenensis Desv., Ges. Naturf. Freunde Berlin Mag. Neuesten Entdeck.

Gesammten Naturk 5: 311. 1811.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11688* (NY); Feijó, *G. T. Prance et al. 7342* (NY), *P. Delprete et al. 8475* (NY); Mâncio Lima, *D. C. Daly et al. 8962* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 7350* (HPZ, NY), *D. C. Daly et al. 10277* (NY); Porto Valter, *M. Silveira et al. 1646* (NY); Santa Rosa, *D. C. Daly et al. 11088* (NY), *D. C. Daly et al. 10166* (NY), *D. C. Daly et al. 11178* (NY); Tarauacá, *D. C. Daly et al. 8619* (HPZ, NY), *G. T. Prance 7267A* (NY); Without locality, *J. Jangoux 85-095* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Polytaenium guayanense (Hieron.) Alston, Kew Bull. 1932(7): 134. 1932.
Anthrophyum guaynense Hieron., Hedwigia 57: 212. 1915.
Habit/Habitat: Herb; epiphyte in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1316* (HPZ), *J. Prado et al. 1351* (HPZ); Marechal Thaumaturgo, *D. C. Daly et al. 10254* (NY), *D. C. Daly et al. 10837* (NY); Porto Valter, *W. C. Steward et al. P13013* (MG, NY); Rodrigues Alves, *J. Prado et al. 1240* (HPZ, SP), *J. Prado et al. 1248* (HPZ, SP), *J. Prado et al. 1277* (HPZ, SP); Without locality, *J. Jangoux et al. 85-026* (NY), *J. Jangoux et al. 85-095A* (NY).
Distribution: N South America.

Pteris altissima Poir., Encycl. 5: 722. 1804.
Habit/Habitat: Herb; terrestrial in forested slope between Baixio and higher terrace, canopy relatively closed, understory relatvely rich in herbs.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 9879* (HPZ, NY); Manoel Urbano, *D. C. Daly et al. 9086* (NY), *D. C. Daly et al. 11195* (NY), *D. C. Daly et al. 11260* (NY), *D. C. Daly et al. 11422* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7702* (NY); Santa Rosa, *D. C. Daly et al. 10054* (HPZ, NY); Tarauacá, *G. T. Prance et al. 799* (NY), *G. T. Prance et al. 7259* (INPA, K, NY, US, R), *G. T. Prance et al. 7299* (NY), *D. C. Daly et al. 8317* (NY), *M. Silveira et al. 997* (NY); Without locality, *J. Jangoux et al. 85-063* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Pteris grandifolia L., Sp. Pl. 2: 1073. 1753.
Habit/Habitat: Herb; terrestrial on substrate hard and brittle, seeping clear water.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11697* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10198* (NY); Porto Valter, *P. J. M. Maas et al. 13239* (K, NY).
Distribution: Mexico, Antilles, Mesoamerica, N South America.

Pteris haenkeana C. Presl, Reliq. Haenk. 1(1): 55. 1825.
Habit/Habitat: Herb; terrestrial in moist forest on Terra Firme, tertiary sediments, undulating terrain.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9791* (HPZ, NY); Manoel Urbano, *D. C. Daly et al. 11426* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 7341* (NY); Santa Rosa, *D. C. Daly et al. 11314* (NY).
Distribution: N South America.

Pteris propinqua J. Ag., Recens. Spec. Pter. 65. 1839.
Habit/Habitat: Herb; terrestrial in undisturbed forest in low-lying area with moist soils, canopy open.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11475* (NY); Sena Madureira, *D. C. Daly et al. 7920* (MO); Marechal Thaumaturgo, *D. C. Daly et al.10465* (NY); Rio Branco, *L. Coêlho & A. Rosas 1941* (HPZ, NY).
Distribution: Mexico, Mesoamerica and tropical South America.

Pteris pungens Willd., Sp. Pl. 5: 387. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Without locality, *J. Jangoux et al. 0* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Vittaria lineata (L.) Sm., Mem. Acad. Roy. Sci. (Turin) 5(1790-1791): 421, pl. 9, fig. 5. 1793.
Pteris lineata L., Sp. Pl. 2: 1073. 1753.
Habit/Habitat: Herb; epiphyte in forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *P. J. M. Maas et al. P12768* (NY); Mâncio Lima, *J. Prado et al. 1227* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1279* (HPZ, SP).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

SACCOLOMATACEAE
Saccoloma elegans Kaulf., Berlin. Jahrb. Pharm. Verbundenen Wiss. 21: 51. 1820.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1341* (HPZ, SP); Sena Madureira, *C. A. Cid & B. Nelson 2574* (NY); Without locality, *J. Jangoux et al. 85-100* (MG, NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Saccoloma inaequale (Kunze) Mett., Ann. Sci. Nat., Bot., ser. 4, 15: 80. 1861.
Davallia inaequalis Kunze, Linnaea 9: 87. 1834.
Habit/Habitat: Herb; terrestrial on Terra Firme forest on high terrace.
Material examined: BRAZIL. ACRE: Bujari, *D. C. Daly et al. 9456* (NY); Cruzeiro do Sul, *G. T. Prance et al. 12194* (MG, NY), *G. T. Prance et al. 12333* (NY), *G. T. Prance et al.12574* (NY), *J. Prado et al. 1203* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1256* (HPZ, SP); Santa Lucia, *J. Pruski et al. 3497* (NY); Without locality, *J. Jangoux et al. 85-011* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Saccoloma membranaceum Mickel, Amer. Fern J. 74: 119, fig. 2A, B. 1984.
Habit/Habitat: Herb; terrestrial in forest on mountains.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12432* (NY).
Distribution: N South America.

SALVINIACEAE
Salvinia minima Baker, J. Bot. 24: 98. 1886.
Habit/Habitat: Herb; aquatic in lakes along road margins.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1378* (HPZ, SP).
Distribution: S United States, Mexico, Antilles, Mesoamerica and tropical South America.

SCHIZAEACEAE

Schizaea elegans (Vahl) Sw., J. Bot. (Schrader) 1800(2): 103. 1801.
Acrostichum elegans Vahl, Symb. Bot. 2: 104, tab. 50. 1791.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1162* (HPZ, SP), *J. Prado et al. 1175* (HPZ, SP), *J. Prado et al. 1307* (HPZ, SP); Mâncio Lima, *C. A. Cid et al. 10095* (NY), *G. T. Prance et al. 12101* (NY), *M. Silveira et al. 1259* (NY).
Distribution: S Mexico, Greater Antilles, Mesoamerica and tropical South America.

SELAGINELLACEAE

Selaginella anceps (C. Presl) C. Presl, Abh. Konigl. Bohm. Ges. Wiss., ser. 5, 3: 581. 1845.
Lycopodium anceps C. Presl, Reliq. Haenk. 1(1): 80. 1825.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Sena Madureira, *D. C. Daly et al. 7891* (NY), *D. C. Daly et al. 8139* (NY).
Distribution: Mesoamerica and N South America.

Selaginella asperula Spring, Fl. Bras. 1(2): 127. 1840.
Habit/Habitat: Herb; terrestrial in Campina forest, on sandy soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 10646* (NY), *G. T. Prance et al. 12643* (NY), *J. Prado et al. 1169* (HPZ, SP), *J. Prado et al. 1185* (HPZ, SP), *J. Prado et al. 1192* (HPZ, SP), *J. Prado et al. 1391* (HPZ, SP), *T. B. Croat & A. Rosas Jr. 62643* (HPZ, NY); Porto Valter, *D. C. Daly et al. 7573* (HPZ, NY).
Distribution: N South America.

Selaginella exaltata (Kunze) Spring, Bull. Acad. Roy. Sci. Bruxelles 10(1): 234. 1843.
Lycopodium exaltatum Kunze, Linnaea 9: 8. 1834[1835].
Habit/Habitat: Herb; terrestrial in forest on Terra Firme and Várzea forest.
Material examined: BRAZIL. ACRE: Bujari, *W. A. Anderson 12124* (NY); Brasiléia, *D. C. Daly et al. 6820* (HPZ, NY); Cruzeiro do Sul, *J. Prado et al. 1289* (HPZ, SP), *L. R. Marinho 258* (NY); Mâncio Lima, *G. T. Prance et al. 12157* (NY), *J. Jangoux et al. 85-093* (MG, NY); Plácido de Castro, *D. C. Daly et al. 6123* (HPZ, NY); Porto Valter, *P. J. M. Maas et al. P12951* (MG, NY); Rio Branco, *D. C. Daly et al. 6676* (HPZ, NY); Sena Madureira, *B. Nelson et al. 527* (NY), *G. T. Prance et al. 7626* (NY); Tarauacá, *G. T. Prance et al. 7405* (NY); Xapuri, *A. R. S. Oliveira et al. 198* (MG, NY); Without locality, *E. Forero et al. 6305* (NY).
Distribution: Mesoamerica and N South America.

Selaginella flagellata Spring, Bull. Acad. Roy. Sci. Bruxelles 10(1): 228. 1843.
Habit/Habitat: Herb; terrestrial in "Baixio": low terraces possibly flooded occasionally by overflowing streams.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 11439* (NY).
Distribution: Mexico, Mesoamerica and tropical South America.

Selaginella haematodes (Kunze) Spring, Fl. Bras. 1(2): 126. 1840.
Lycopodium haematodes Kunze, Linnaea 9: 9. 1834[1835].
Habit/Habitat: Herb; terrestrial in open forest on steep hilly terrain.
Material examined: BRAZIL. ACRE: Santa Rosa, *D. C. Daly et al. 11141* (NY).
Distribution: Mesoamerica and N South America.

Selaginella parkeri (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Bruxelles 10: 146. 1843.
Lycopodium parkeri Hook. & Grev., Bot. Misc. 2: 388. 1843.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12305* (NY), *J. Prado et al. 1155* (HPZ, SP), *J. Prado et al. 1156* (HPZ, SP), *J. Prado et al. 1184* (HPZ, SP), *J. Prado et al. 1193* (HPZ, SP), *J. Prado et al. 1319* (HPZ, SP); Mâncio Lima, *G. T. Prance et al. 12200* (NY); Rodrigues Alves, *J. Prado et al. 1362* (HPZ, SP).
Distribution: N South America.

Selaginella sulcata (Desv. ex Poir.) Spring ex Mart., Flora 20(2): 126. 1837.
Lycopodium sulcatum Desv. ex Poir., Encycl. 3: 549. 1814.
Habit/Habitat: Herb; terrestrial in forest on Terra firme, on poorly drained soils, undulating terrain dissected by numerous streams.
Material examined: BRAZIL. ACRE: Manoel Urbano, *D. C. Daly et al. 9134* (NY); Sena Madureira, *D. C. Daly et al. 8075* (NY), *L. de Lima et al. 540* (HPZ, NY).
Distribution: Tropical South America.

TECTARIACEAE
Tectaria draconoptera (D. C. Eaton) Copel., Philipp. J. Sci. 2C: 410. 1907.
Aspidium draconopterum D. C. Eaton, Mem. Amer. Acad. Arts, n.s., 8: 211. 1860.
Habit/Habitat: Hervb; terrestrial, in primary forest, unudulating terrain, in places dissected by many small streams.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 9882* (HPZ, NY), *D. C. Daly et al. 11891*(NY).
Distribution: Mesoamerica and N South America.

Tectaria incisa Cav., Descr. Pl. 249. 1802.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins, on sandy and clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7493* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 10340* (NY), *D. C. Daly et al. 10343* (NY); Quixadá, *C. A. Cid & A. Rosas 2952* (MG, NY); Rio Branco, *C. A. Cid & A. Rosas 2899* (NY); Santa Rosa, *D. C. Daly et al. 10052* (NY), *D. C. Daly et al. 11335* (NY); Sena Madureira, *G. T. Prance et al. 7667* (MG, NY); Tarauacá, *D. C. Daly et al. 8617* (HPZ, NY) ,*G. P. da Silva et al. 98* (NY); Xapuri, *C. Figueiredo 207* (HPZ, NY), Xapuri, *D. C. Daly et al. 7273* (HPZ, NY).
Distribution: S Florida, Mexico, Antilles, Mesoamerica, tropical and subtropical South America.

Tectaria aff. ***longipinnata*** A. Rojas, Revista Biol. Trop. 49: 476, fig. 5. 2001.
Habit/Habitat: Herb; terrestrial on Várzea forest.

Material examined: BRAZIL. ACRE: Mâncio Lima, *G. T. Prance et al. 12047* (MG, NY), *M. Silveira et al.1229* (NY); Rio Branco, *C. A. Cid & A. Souza 2988* (NY); Sena Madureira, *G. T. Prance et al. 7812A* (NY).
Distribution: Mesoamerica and tropical South America.

Tectaria trifoliata (L.) Cav., Descr. Pl. 249. 1802.
Polypodium trifoliatum L., Sp. Pl. 2: 1087. 1753.
Habit/Habitat: Herb; terretrial in forest of Terra Firme, on undulating terrain, canopy discontinuous.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 1229* (HPZ, NY).
Distribution: Antilles and N South America.

Triplophyllum boliviense J. Prado & R. C. Moran, Brittonia 60: 106 figs 5, 6. 2008.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, undulating terrain.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9883* (HPZ, NY); Brasiléia, *D. C. Daly et al. 8463* (HPZ, NY); Bujari, *D. C. Daly et al. 9856* (HPZ, NY).
Distribution: N South America.

Triplophyllum funestum (Kunze) Holttum, Kew Bull. 41: 255. 1986.
Aspidium funestum Kunze, Linnaea 9: 96. 1834.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on clay soils.
Material examined: BRAZIL. ACRE: Brasiléia, *D. C. Daly et al. 7091* (NY); Cruzeiro do Sul, *J. Prado et al. 1334* (HPZ, SP); Rodrigues Alves, *J. Prado et al. 1247* (HPZ).
Distribution: Antilles, Mesoamerica and N South America.

THELYPTERIDACEAE
Thelypteris angustifolia (Willd.) Proctor, Bull. Inst. Jamaica, Sci. Ser. 5: 57. 1953.
Meniscium angustifolius Willd., Sp. Pl. 5: 133. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on sandy soil.
Material examined: BRAZIL. ACRE: Mâncio Lima, *M. Silveira et al. 1292* (NY), *M. Silveira et al. 1299* (NY), *D. C. Daly et al. 8921* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 10196* (NY); Tarauacá, *D. C. Daly et al. 8764* (HPZ, NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Thelypteris arborescens (Humb. & Bonpl. ex Willd.) C. V. Morton, Contr. U.S. Natl. Herb. 38: 50. 1967.
Meniscium arborescens Humb. & Bonpl. ex Willd., Sp. Pl. 5: 133. 1810.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1164* (HPZ, SP), *J. Prado et al. 1298* (HPZ, SP).
Distribution: Mesoamerica and tropical South America.

Thelypteris chrysodioides (Fée) C. V. Morton, Contr. U.S. Natl. Herb. 38: 51. 1967.
Meniscium chrysodioides Fée, Mem. Foug. 5: 225. 1852.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *T. B. Croat & A. Rosas Jr. 62670* (HPZ, NY).
Distribution: N South America.

Thelypteris decussata (L.) Proctor, Bull. Inst. Jamaica, Sci. Ser. 5: 59. 1953.
Polypodium decussatum L., Sp. Pl. 2: 1093. 1753.
Infraspecific: var. ***decussata***
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on steep slopes.
Material examined: BRAZIL. ACRE: Rodrigues Alves, *J. Prado et al. 1370* (HPZ, SP).
Distribution: Antilles, Mesoamerica and tropical South America.

Thelypteris jamesonii (Hook.) R. M. Tryon, Rhodora 69: 6. 1967.
Nephrodium jamesonii Hook., Sp. Fil. 4: 66. 1862.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme, on steep slopes.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11698* (NY).
Distribution: N South America and southern Brazil.

Thelypteris juruensis (C. Chr.) R. M. Tryon & D. S. Conant, Acta Amazon. 5: 33. 1975.
Dryopteris juruensis C. Chr., Kongel. Danske Vidensk. Selsk. Skr., Naturvidensk. Math. Afd., ser. 7, 10(2): 256, fig. 43d. 1913.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *P. J. M. Maas et al. P12981* (NY); Manoel Urbano, *D. C. Daly et al. 11391* (NY); Rio Branco, *C. A. Cid & A. Rosas 2950* (NY); Sena Madureira, *G. T. Prance et al. 7812* (NY), *G. T. Prance et al. 7853* (NY).
Distribution: N South America and southern Brazil.

Thelypteris macrophylla (Kunze) C. V. Morton, Amer. Fern J. 61: 17. 1971.
Meniscium macrophyllum Kunze, Flora 22(1): Beibl. 44. 1838.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1337* (HPZ, SP).
Distribution: N South America and southern Brazil.

Thelypteris membranacea (Mett.) R. M. Tryon, Rhodora 69: 7. 1967.
Phegopteris membranacea Mett., Fil. Lechl. 2: 22. 1859.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Mâncio Lima, *M. Silveira et al. 1249* (NY).
Distribution: N South America.

Thelypteris opposita (Vahl) Ching, Bull. Fan Mem. Inst. Biol., Bot. 10: 253. 1941.
Polypodium oppositum Vahl, Eclog. Amer. 3: 53. 1807.
Habit/Habitat: Herb; terrestrial, riverside vegetation.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9644* (HPZ, NY), *D. C. Daly et al. 9653* (HPZ, NY).
Distribution: Antilles, Mesoamerica and tropical South America.

Thelypteris opulenta (Kaulf.) Fosberg, Smithsonian Contr. Bot. 8: 3. 1972.
Aspidium opulentum Kaulf., Enum. Fil. 238. 1824.
Habit/Habitat: Herb; terrestrial in open forest with palms and weak presence of Guadua sarcocarpa, canopy ca. 25 m, deeply dissected terrain. Sandy clay soil.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 11858* (NY), *G. T. Prance et al. 12428* (MG, NY), *L. R. Marinho 204* (NY), *P. J. M. Maas et al.*

P13304 (NY), *J. Prado et al. 1333* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1144* (HPZ, SP); Manoel Urbano, *D. C. Daly et al. 10458* (NY), *D. C. Daly et al. 11498* (NY); Marechal Thaumaturgo, *D. C. Daly et al. 10366* (NY); Porto Acre, *C. Figueiredo & I. Riveiro 751* (NY); Santa Rosa, *D. C. Daly et al. 10158* (NY), *D. C. Daly et al. 11098* (NY), *D. C. Daly et al. 11327* (NY); Sena Madureira, *G. T. Prance et al. 7662* (NY), *L. de Lima et al. 553* (HPZ, NY); Xapuri, *L. G. Lohmann & E. C. de Oliveira 598* (NY).
Distribution: Antilles, Mesoamerica, N South America. Native to Asia and Africa.

Thelypteris patens (Sw.) Small, Ferns S. E. States 243. 1938.
Polypodium patens Sw., Prodr. 133. 1788.
Habit/Habitat: Herb; terrestrial in forest on steep slopes.
Material examined: BRAZIL. ACRE: Assis Brasil, *D. C. Daly et al. 9635* (NY); Porto Valter, *D. C. Daly et al. 11780* (NY).
Distribution: Mexico, Antilles, Mesoamerica and tropical South America.

Thelypteris serrata (Cav.) Alston, Bull. Misc. Inform. Kew 1932: 309. 1932.
Meniscium serratum Cav., Descr. Pl. 548. 1802.
Habit/Habitat: Herb; terrestrial in primary moist forest on Terra Firme.
Material examined: BRAZIL. ACRE: Brasiléia, *S. R. Lowrie & B. Nelson 695* (MG, NY); Rio Branco, *D. C. Daly et al. 6882* (HPZ, NY), *E. Forero et al. 6377* (MG, NY).
Distribution: S Florida, Antilles, Mesoamerica, tropical and subtropical South America.

Thelypteris tristis (Kunze) R. M. Tryon, Rhodora 69: 8. 1967.
Polypodium triste Kunze, Linnaea 9: 47. 1834.
Habit/Habitat: Herb; terrestrial in forest of Terre Firme, on clay soils.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1376* (HPZ, SP); Mâncio Lima, *J. Prado et al. 1138* (HPZ, SP); Porto Valter, *D. C. Daly et al. 11767* (NY).
Distribution: Mesoamerica and tropical South America.

WOODSIACEAE
Diplazium ambiguum Raddi, Opusc Sci. 3: 292. 1819.
Habit/Habitat: Herb; terrestrial on disturbed area of Terra Firme.
Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, *D. C. Daly et al. 10464* (NY).
Distribution: tropical South America.

Diplazium grandifolium (Sw.) Sw., J. Bot. (Schrader) 1800(2): 62. 1801.
Asplenium grandifolium Sw., Prodr. 130. 1788.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme near stream margins.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *D. C. Daly et al. 7394* (HPZ, NY); Marechal Thaumaturgo, *D. C. Daly et al. 10302* (NY); Xapuri, *M. Pinard et al. 812* (NY).
Distribution: Mexico, Antilles, Mesoamerica and N South America.

Diplazium lechleri (Mett.) T. Moore, Index Filic. 141. 1859.
Asplenium lechleri Mett., Fil. Lechl. 1: 16, tab. 2. 1856.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.

Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *J. Prado et al. 1332* (HPZ, SP).

Diplazium praestans (Copel.) Maxon & C. V. Morton, Contr. U.S. Natl. Herb. 38: 41. 1967.
Athyrium praestans Copel., Amer. Fern J. 38: 132. 1948.
Habit/Habitat: Herb; terrestrial in forest on Terra Firme.
Material examined: BRAZIL. ACRE: Marechal Thaumaturgo, *D. C. Daly et al. 7721* (HPZ, NY); Tarauacá, *G. T. Prance et al. 7400* (MG, NY).
Distribution: N South America.

Hemidictyum marginatum (L.) C. Presl, Tent. Pterid. 111, tab. 3, fig. 24. 1836.
Asplenium marginatum L., Sp. Pl. 2: 1082. 1753.
Habit/Habitat: Herb; terrestrial in Várzea forest.
Material examined: BRAZIL. ACRE: Cruzeiro do Sul, *G. T. Prance et al. 12479* (NY).
Distribution: S Mexico, Antilles, Mesoamerica, tropical South America.

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DESICCATION TOLERANCE IN SOME BRITISH FERNS

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Key-words: *Asplenium*, chlorophyll fluorescence, drying rate, light responses, *Polypodium*, recovery rate, relative humidity, relative water content.

ABSTRACT

Leaves of ten British fern species were tested for their tolerance of desiccation. *Asplenium ruta-muraria*, *A. septentrionale*, *A. trichomanes*, *A. ceterach*, *Polypodium cambricum* and *P. interjectum* withstood drying for periods of a week or more to a relative water content (RWC) of *c.* 4–7%. This is far below the RWC (*c.* 30%) at which most vascular-plant tissues are irretrievably damaged. One population of *Asplenium adiantum-nigrum* was desiccation tolerant, another was not. *Aspelnium obovatum* was fairly tolerant, behaviour differing with intensity of desiccation and in old and young growth. *Polypodium cambricum* and *P interjectum* were both highly tolerant. *Polystichum aculeatum* was not tolerant. Recovery rates of RWC and the chlorophyll-fluorescence parameter F_v/F_m did not vary greatly between species, with half-recovery times around 2–4 h. The small *Asplenium* species and *A. ceterach* dried quickly (half-drying times a few hours), suggesting little stomatal control over drying. The much slower drying of the *Polypodium* species suggests that their stomata close under water stress. Photosynthetic electron flow in most species saturated at a quarter to a half of full summer sunlight. *Asplenium ruta-muraria*, *A. septentrionale* and *A. trichomanes* showed a similar tendency to non-saturating electron flow at high irradiances as many desiccation-tolerant bryophytes. In *A. ceterach* and *Polypodium cambricum* electron flow was somewhat depressed at high irradiances. The results are discussed in relation to their ecological and evolutionary implications.

INTRODUCTION

The tolerance to desiccation of the rusty-back fern *Asplenium ceterach* L., the widespread Mediterranean *Notholaena marantae* (L.) Desv. and the American 'resurrection' ferns *Polypodium polypodioides* (L.) Watt and *P. virginiacum* L. is well known (Oppenheimer & Halevy, 1962; Schwab *et al.*, 1989; Iljin, 1931; Potts & Penfound, 1948; Stuart, 1968; Gildner & Larson, 1992; Muslin & Homann, 1992; Reynolds & Bewley, 1993). Many other ferns have been reported as desiccation tolerant, including a number of species of *Cheilanthes*, *Pellaea*, *Asplenium* and *Polypodium*; a list with references was given by Proctor & Pence (2002) and further species were added by Kessler & Siorak (2007). Most of these are essentially ferns of seasonally arid regions, or saxicolous or epiphytic species of intermittently water-stressed habitats. Kappen (1964) investigated freezing, heat and drought tolerance round the seasons of the common ferns around Göttingen in central Germany. He found no sharp line between poikilohydric, desiccation-tolerant ferns and homoiohydric, more sensitive species, as did Kessler & Siorak in North America. In general, Kappen found

the summer-green ferns were sensitive to drying at all times, but most winter-green species were more tolerant of drying in the cold, dry Central European winter and spring than from midsummer to autumn. The most desiccation-tolerant species (in descending order of tolerance) were *Polypodium vulgare*, *Asplenium septentrionale*, *A. ruta-muraria* and *A. trichomanes*. Perhaps paradoxically, there is as much physiological information on desiccation tolerance of the moisture-loving Hymenophyllaceae as on most other ferns (Shreve, 1911; Holloway, 1923a, b; Härtel, 1940a, b; Richards & Evans, 1972; Proctor, 2003).

The response of *Asplenium ceterach* to desiccation and its ability to revive after rain are very apparent in dry summers. The desiccation tolerance of the two common small saxicolous *Asplenium* species is less obvious until they are observed closely. The present project grew out of work on desiccation tolerance in bryophytes, and developed over a number of years as opportunity offered or material came to hand. Its aims were to establish which of our common ferns are tolerant to desiccation, and to collect data on the desiccation-tolerance of ferns (in particular rates of drying and recovery) for comparison with bryophytes and angiosperm 'resurrection plants.'

MATERIALS AND METHODS

All the measurements in this paper were made on excised leaves. Material of *Asplenium trichomanes*, *A. ruta-muraria*, *A. ceterach* and *Polypodium cambricum* was collected from Devonian limestone rocks and walls near Chudleigh, Devon (most on 10 December 2000 and 5 January 2001; some *A. ceterach* in March–April 2008). Some measurements were made on leaves of *A. adiantum-nigrum* from a mortared pebble wall facing the sea at Budleigh Salterton, Devon (4 January 2001); most measurements on this species were on material from a dry Permian conglomerate roadside bank at Kennford, Devon (8 February 2006). *A. obovatum* was from schist outcrops on Gammon Head, near East Prawle, Devon (30 April 2006). *A. septentrionale* was from a slate dry-stone roadside wall south of Trefriw, Gwynedd (11 September 2005). *Polypodium interjectum* was from a Permian roadside outcrop near Kennford, Devon (8 February 2006). *Polystichum aculeatum* came from Malham, Yorkshire (26 July 2006).

Chlorophyll fluorescence measurements using a modulated fluorometer (FMS-1, Hansatech, King's Lynn) were used throughout this work. Chlorophyll fluorescence provides a simple and rapid non-invasive method of monitoring various aspects of the photosynthetic performance of a plant. Schreiber *et al.*, (1995) and Maxwell & Johnson (2000) provide an introduction to the technique and explain the calculation of the commonly used parameters. The parameter F_v/F_m measures the maximum quantum efficiency of photosystem II; it is generally in the range 0.76–0.84 in dark-adapted unstressed material, and is widely used as a quick general measure of 'stress' or (conversely) 'viability', and is so used here. The non-photochemical quenching parameter NPQ is largely a measure of photo-protection. The photochemical quenching parameter q_P is a measure of the oxidation state of the first electron acceptor Q_A of photosystem II; it is often used (as here) in the inverse form $1-q_P$.

In the light, the effective quantum yield of photosystem II (FPSII) multiplied by the irradiance in quantum units (PPFD) provides a relative measure of the rate of electron transport through PSII, and hence of photosynthetic electron flow (RETR). This figure includes not only electron transport resulting in carbon fixation, but also photo-respiration and flow to any other electron sinks. However, under most conditions the bulk of the electron flow will be to carbon fixation, so for many purposes RETR

provides a convenient non-invasive surrogate measure of photosynthetic performance; for comparisons of chlorophyll-fluorescence and gas-exchange data in bryophytes, see Marschall & Proctor (2004) and Proctor *et al.* (2007).

In general, the recovery of both F_v/F_m and RWC were well fitted by logistic curves on a logarithmic timescale. For the RWC curves, and in those cases where F_v/F_m for the dry material was substantially >0.0, a 4-parameter logistic curve was appropriate. This has a lower asymptote corresponding to the value of RWC or F_v/F_m in dry material and an upper asymptote at the maximum (fully recovered) value of F_v/F_m. Where F_v/F_m in dry material was ~0 or unknown, a 3-parameter logistic starting at 0 was fitted. In either case, the IC-50 value (point of inflection) of the curve was taken as a measure of the time for 'half-recovery'. The relation of RETR to irradiance is generally well fitted by negative-exponential curve of the form $y = (A - e^{-kx})$, where y = RETR and x = PPFD and A and k are constants, at least at low irradiances (<400 mmol m^{-2} s^{-1}). Deviations may arise through electron flow to sinks other than photosynthetic carbon fixation (bryophytes often show non-saturating electron flow of this kind (Marschall & Proctor, 2004)), or through photoinhibition depressing electron flow at high irradiances. A useful test of goodness-of-fit of the exponential curve is that the product Ak should approximate to the dark-adapted value of F_v/F_m (c. 7.5–8.5). NPQ is generally well fitted by a logistic curve starting at 0. The parameter $1 - qP$ is also often well fitted by a logistic curve, but the fit is very sensitive to the top few data points, which can lead to misleading estimates of the upper asymptote and IC-50 value; suspect values have been omitted from Table 4.

Some comment may be made on measures of water content and water availability. The water content of desiccation-tolerant plants is often given as a percentage of dry weight. This is useful for comparisons within a population of a single species, but not for comparisons between different populations or different species because of differences in the proportion of cell-wall materials and cell contents. Water content relative to that at full turgor (RWC) is a much more widely useful measurement, and has been emphasised here. Relative humidity (RH) of the air is only useful if the temperature is known (in this paper *c.* 20°C), and its biological relevance is limited. Evaporation rates depend on *saturation deficit*, the difference between the absolute humidity of the air and the saturated absolute humidity at the same temperature (which can be looked up in tables); it is usually expressed in terms of partial pressure of water vapour (kPa). Water potential (Ψ) which defines the tendency for water to move from one place to another, is usually expressed in pressure units (MPa); for air, it can be calculated from relative humidity and temperature. For the physical and mathematical relations between these quantities see, e.g., Slatyer (1967), Nobel (1974), Jones (1992).

RESULTS

Table 1 lists some water-content data for the ferns investigated, expressed as a percentage of oven-dry weight, and as relative water content. Water content at full turgor on a dry-weight basis varies widely even within the same species; at full turgor RWC for all species is 1.0 by definition. A number of measurements were made on 'air dry' material. The figures in the table show clearly that 'air dry' can embrace a substantial range in actual water content measured as RWC; cold dry weather outdoors will tend to give low absolute (and relative) humidity indoors, and warm or humid weather the opposite. Fern material equilibrated in a desiccator at *c.* 74% RH had an RWC around 0.14–0.16; material equlibrated at 43% RH showed RWC mostly below

0.10. Of the air dried material, *Asplenium trichomanes* (1) and *Polypodium cambricum* (1) were probably dried to an equivalent of *c*.60–70% RH at 20 °C, and the other samples at *c*.30–40% RH.

Three small saxicolous Asplenium *species*

The recovery of relative water content and the fluorescence parameter F_v/F_m on re-wetting after a few days' desiccation in *Asplenium ruta-muraria* L.and *A. trichomanes* L. is shown in Figures 1a and 1b and Table 2. *A. trichomanes* that had been dried to 14% RWC recovered rather faster than material dried to a RWC of 7.5%; the half-recovery times of F_v/F_m in the fitted curves of Figure 1b are respectively 1.7 and 3.9 hours, but the asymptotes of the two curves are not significantly different. A much rarer species than either of these in Britain, *A. septentrionale* L. was reported as highly desiccation tolerant by Kappen. Leaves collected from a population in North Wales in September 2005, were allowed to air dry. The chlorophyll fluorometer was not available from then until January 2006, by which time the leaves had been dry for four months. However, on re-wetting (12 Jan.) they recovered their normal fresh appearance and appeared fully turgid the following day. Ten leaves re-wetted after 3 days moist followed by 2 days air dry gave F_v/F_m 0.754 ± 0.035 after 24 h rehydration (Figure 1c). Of these three *Asplenium* species, *A. ruta-muraria* showed the highest light-saturation level, followed by *A. septentrionale* with *A. trichomanes* the lowest; all three showed at least some indication of non-saturating electron flow at high irradiances (Figure 11a).

Two further species of Asplenium

Asplenium adiantum-nigrum L. sometimes accompanies the other small saxicolous *Asplenium* species in crevices of rocks and walls, but usually avoids the most sun-exposed and water-stressed situations. Leaves of this species from a mortared pebble wall facing the sea at Budleigh Salterton were promisingly firm textured, and looked possible candidates for desiccation tolerance. However, re-wetted after a few days' desiccation at 43% RH they showed only slight temporary signs of recovery of F_v/F_m for the first few hours, and by the following day it was clear they would not recover further (Table 2.)

Plants from another population, on a steep dry roadside bank near Kennford, Devon, behaved quite differently. Figure 2 shows the rapid and progressive loss of weight of leaf segments dried at 74% and 43% RH, with fitted exponential curves; the asymptotes approximated to the figures in Table 1; the leaves dried quickly, losing half their water within 6.2 h at 74% RH (–41 MPa) and 4.7 h at 43% RH (–114 MPa). The recovery of F_v/F_m on re-wetting after the two desiccation regimes is shown in Figure 3. The data and the fitted curves suggest that intensity of drying has a marked effect, but neither the asymptotes nor the half-recovery times are significantly different, and the slope factor just fails to reach significance at the 5% level.

Asplenium obovatum Viv. dried rather more slowly than *A. adiantum- nigrum*: the half-drying times seen in Figure 4 are around 11 h at 74% RH and 9 h at 43% RH Recovery of F_v/F_m on re-wetting was both less complete and more variable than in the Kennford *A. adiantum-nigrum*. After drying at 74% RH, the dark green leaves of the previous season showed only a transient rise in F_v/F_m on re-wetting; further recovery failed completely. However, in material dried at 43% RH, the older leaves recovered consistently and well. The bright green new-season's leaves recovered well from drying at 74% RH, but very erratically from the 43% RH treatment (Figure 5).

Table 1. Water content of fern leaves at full turgor (as % oven-dry weight at 70°C), and 'air dry' and in equlibrium with air at 74% RH (c. –40 MPa at 20°C) and 43% RH (*c.* –114 MPa at 20°C) as % dry weight and as relative water content (RWC). The two sets of measurements on *Asplenium trichomanes* and *Polypodium cambricum* were both from Chudleigh, in Dec. 2000 and Jan. 2001 respectively. *A. adiantum-nigrum* (1) is from Budleigh Salterton; *A. adiantum-nigrum* (2) is from Kennford.

Species	Full turgor%DW	Water content 'air dry'		Water content at 74% RH (-41 MPa)		Water content at 43% RH (-114 MPa)	
		%DW	RWC	%DW	RWC	%DW	RWC
Asplenium ruta-muraria	409 ± 16	20.9 ± 4.4	0.068 ± 0.013	-	-	-	-
A. trichomanes (1)	139 ± 4	19.3 ± 4.6	0.140 ± 0.037	-	-	-	-
A. trichomanes (2)	108 ± 11	7.9 ± 0.8	0.075 ± 0.014	-	-	-	-
A. adiantum-nigrum (1)	344 ± 36	29.6 ± 2.9	0.087 ± 0.017	-	-	-	-
A. adiantum-nigrum (2)	170 ± 22	-	-	26.1 ± 4.7	0.155 ± 0.045	17.4 ± 2.2	0.106 ± 0.022
A. obovatum	279 ± 82	-	-	33.9 ± 9.2	0.106 ± 0.035	18.1 ± 5.0	0.055 ± 0.035
A. ceterach	156 ± 34	9.4 ± 0.4	0.063 ± 0.018	-	-	-	-
Polypodium cambricum (1)	110 ± 16	18.6 ± 8.3	0.167 ± 0.056	-	-	-	-
Polypodium cambricum (2)	213 ± 10	-	-	33.2 ± 5.7	0.161 ± 0.026	15.8 ± 1.9	0.072 ± 0.006
P. interjectum	306 ± 35	-	-	44.3 ± 13.7	0.142 ± 0.031	15.7 ± 4.6	0.052 ± 0.015

The rusty-back fern, Asplenium ceterach

The curling of the dry leaves in *Asplenium ceterach* initially prevented measurement of F_v/F_m in the early stages of rehydration, so the data in Figure 6 are from leaves dried under light pressure to keep them flat. The rise in F_v/F_m was rather slower to get going in *A. ceterach*, but climbed more steeply once it had started. Light saturation was reached at around half noon summer sunlight, but showed some depression of electron flow at higher irradiances.

An experiment with Polystichum aculeatum *(L.) Roth*

Pinnae of *Polystichum aculeatum* dried rather quickly, giving half-drying times of 12.9 h at 74% RH and 8.4 h at 43% RH, reaching practical equilibrium with the atmosphere in the desiccator in the course of a week. The corresponding equilibrium water contents (asymptotes of the curves) were 0.109 and 0.069 RWC. Remoistened after 9 days, they showed small but erratic increases of F_v/F_m for an hour or two, but these were not maintained and by the following day it was clear that all the pinnae were moribund.

The polypodies, Polypodium cambricum *L. and* P. interjectum *Shivas*

These two species were very tolerant of desiccation, and differ in important respects from the ferns just considered. They dried very much more slowly (Figure 7); the half-drying times for *P. interjectum* at 74% RH (–41 MPa) and 43% RH (–114 MPa) were respectively 2.33 days (56 h) and 1.4 days (34 h). These drying times are almost an order of magnitude longer than those seen in *Asplenium adiantum-nigrum*, around five times longer than in *A. obovatum*. As a consequence, the asymptotes of the exponential curves, 0.074 and 0.037 RWC respectively, are substantially below the figures in Table 1 from weighings after a week's drying. Clearly these latter figures do not reflect equilibrium with the air.

The recovery curves of F_v/F_m in Figures 8 and 9 thus start from relative water contents above equilibrium with the ambient air – but still well below levels at which normal metabolism is possible, or survivable by typical vascular-plant mesophyll tissues. The curves differ significantly only in the initial level of F_v/F_m. Little sign of recovery is apparent in the first hour after re-wetting, either in the physical appearance of the leaves (Figure 10) or in F_v/F_m, but after that recovery is rapid. The half-recovery times are around 2h, and in the same range as in the other species examined (Table 3).

Photosynthetic electron flow saturated at around 40% of noon summer sunlight, but was markedly depressed at high irradiances so that the effective saturation irradiance must be below the $PPFD_{95\%}$ figure in Table 4 (Figure 11b).

DISCUSSION

The results confirm that the leaves of some ferns are remarkably tolerant to desiccation, recovering well from drying for a week or more to a water content of 15–20% of their dry weight, and a tissue relative water content (RWC) of 4–7%. The mesophyll of typical vascular plants is generally damaged beyond recovery if RWC falls below about 30% (or a water potential below about –7 MPa), so these ferns are far more tolerant of desiccation than most drought-tolerant vascular plants (Larcher 1995). Their tolerance is comparable with such mosses as *Tortula* (*Syntrichia*) *ruralis* or *Racomitrium lanuginosum*. However it is also clear there are degrees of desiccation tolerance, and that tolerance may vary within species. Of our *Asplenium species*, *A. septentrionale* is

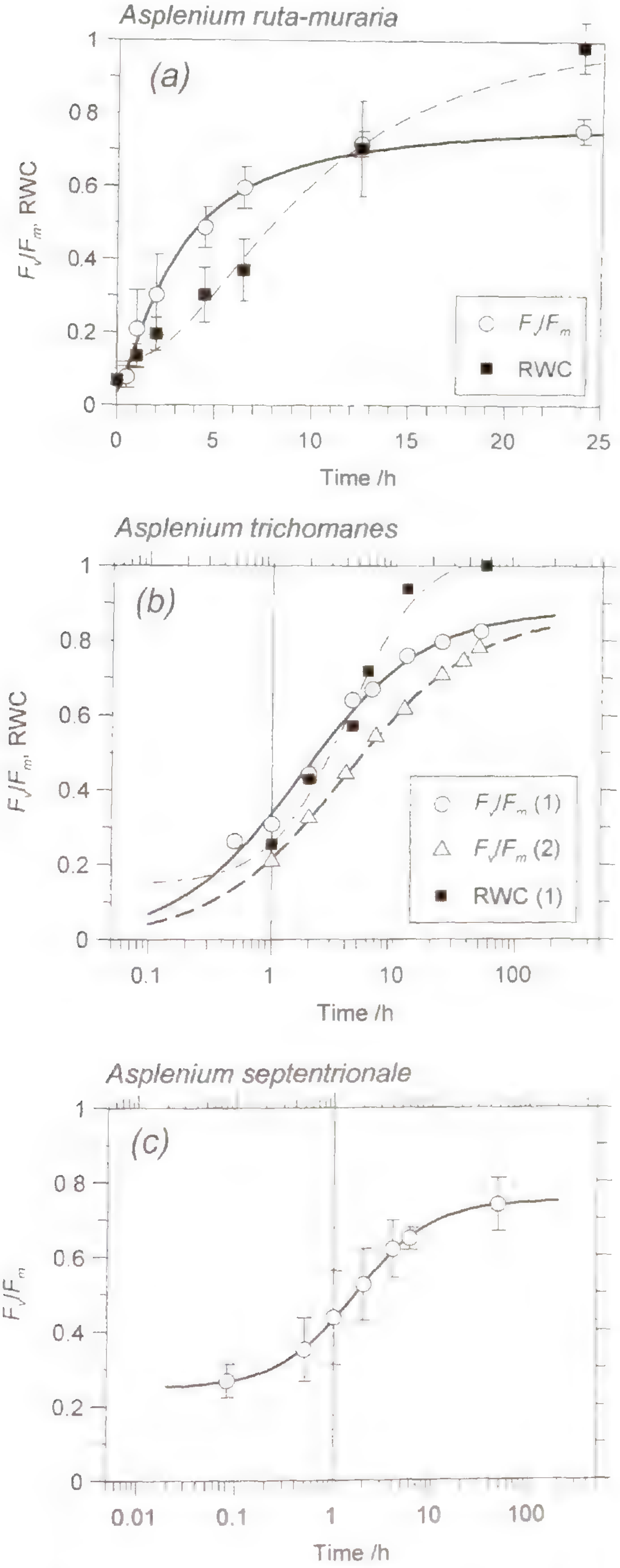

Figure 1. Recovery on remoistening of *(a)* F_v/F_m and RWC in air-dry leaves of *Asplenium ruta-muraria*. Fitted logistic curves. Mean ± s.d., n = 3, *(b)* F_v/F_m in two samples of air-dry leaves of *A. trichomanes* (sample (1) from 0.140 RWC, (2) from 0.075 RWC), and recovery of RWC for sample (1). Means (n = 3), error bars omitted for clarity (log scale), *(c)* F_v/F_m in *A. septentrionale* after four months air dry, with fitted 4-parameter logistic curve. Mean ± s.d., n = 6.

Table 2. F_v/F_m at full turgor before desiccation and 24 h after rehydration.

Species	F_v/F_m at full turgor before desiccation	F_v/F_m after 24 h rehydration		
		'Air-dry'	74% RH (-41 MPa)	43% RH (-114 MPa)
Asplenium ruta-muraria	-	0.756 ± 0.035	-	-
A. trichomanes (1)	-	0.796 ± 0.020	-	-
A. trichomanes (2)	-	0.707 ± 0.059	-	-
A. adiantum-nigrum (1)	-	0.075 ± 0.059	-	-
A. adiantum-nigrum (2)	0.785 ± 0.037	-	0.735 ± 0.053	0.646 ± 0.075
A. obovatum	0.800 ± 0.017	-	0.520 ± 0.122*	0.417 ± 0.113
A. ceterach	0.816 ± 0.018	-	0.812 ± 0.004	0.789 ± 0.023
Polypodium cambricum (1)	-	0.703 ± 0.109	-	-
Polypodium cambricum (2)	0.868 ± 0.012	-	0.832 ± 0.033	0.769 ± 0.047
P. interjectum	0.821 ± 0.017	-	0.824 ± 0.010	0.813 ± 0.019

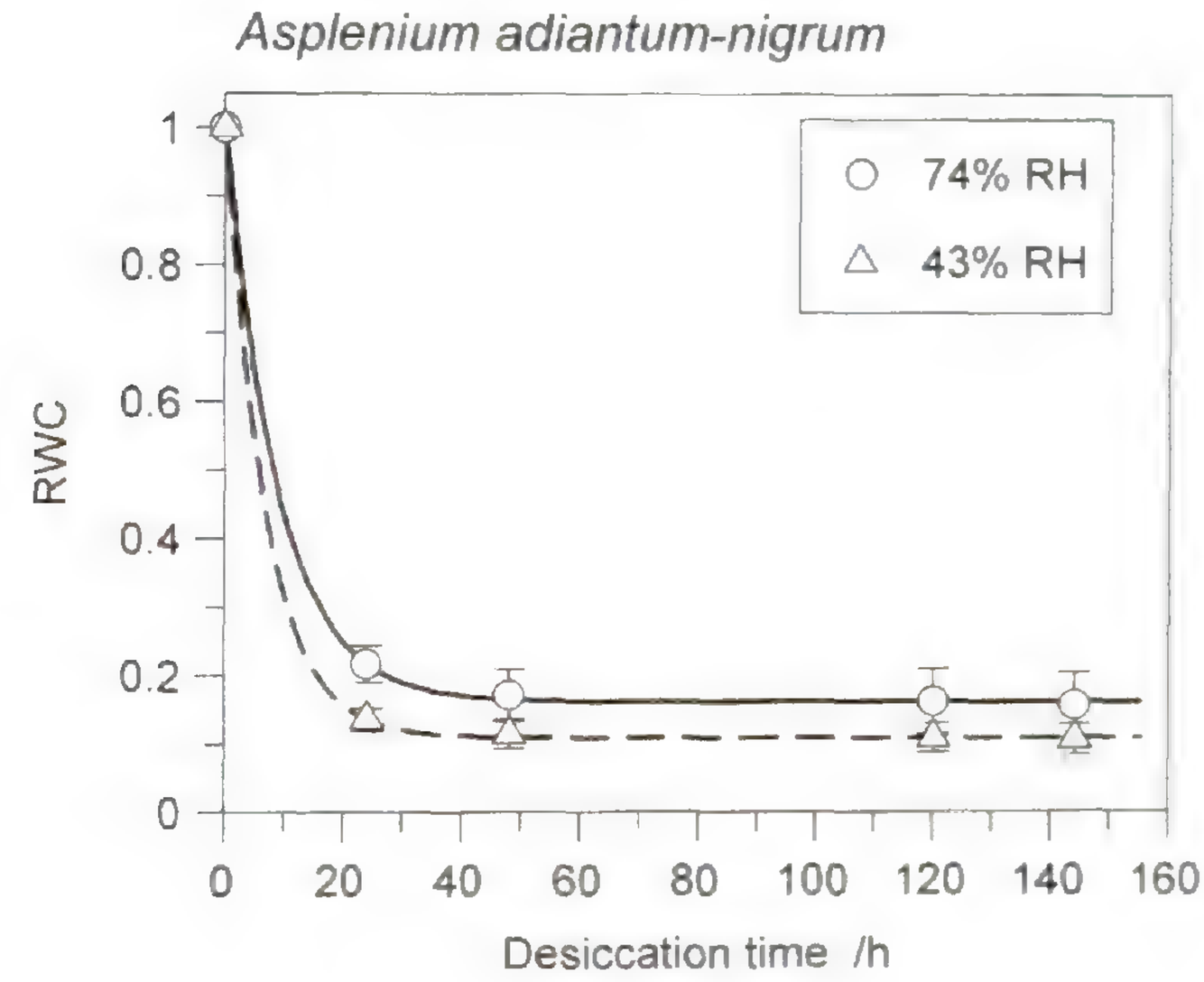

Figure 2. Drying data for leaves of *Asplenium adiantum-nigrum* in desiccators at ~74% and 43% RH (–41 and –114 MPa); the fitted exponential curves give half-drying times of respectively 6.2 h and 4.7 h. Means ± s.d., $n = 6$.

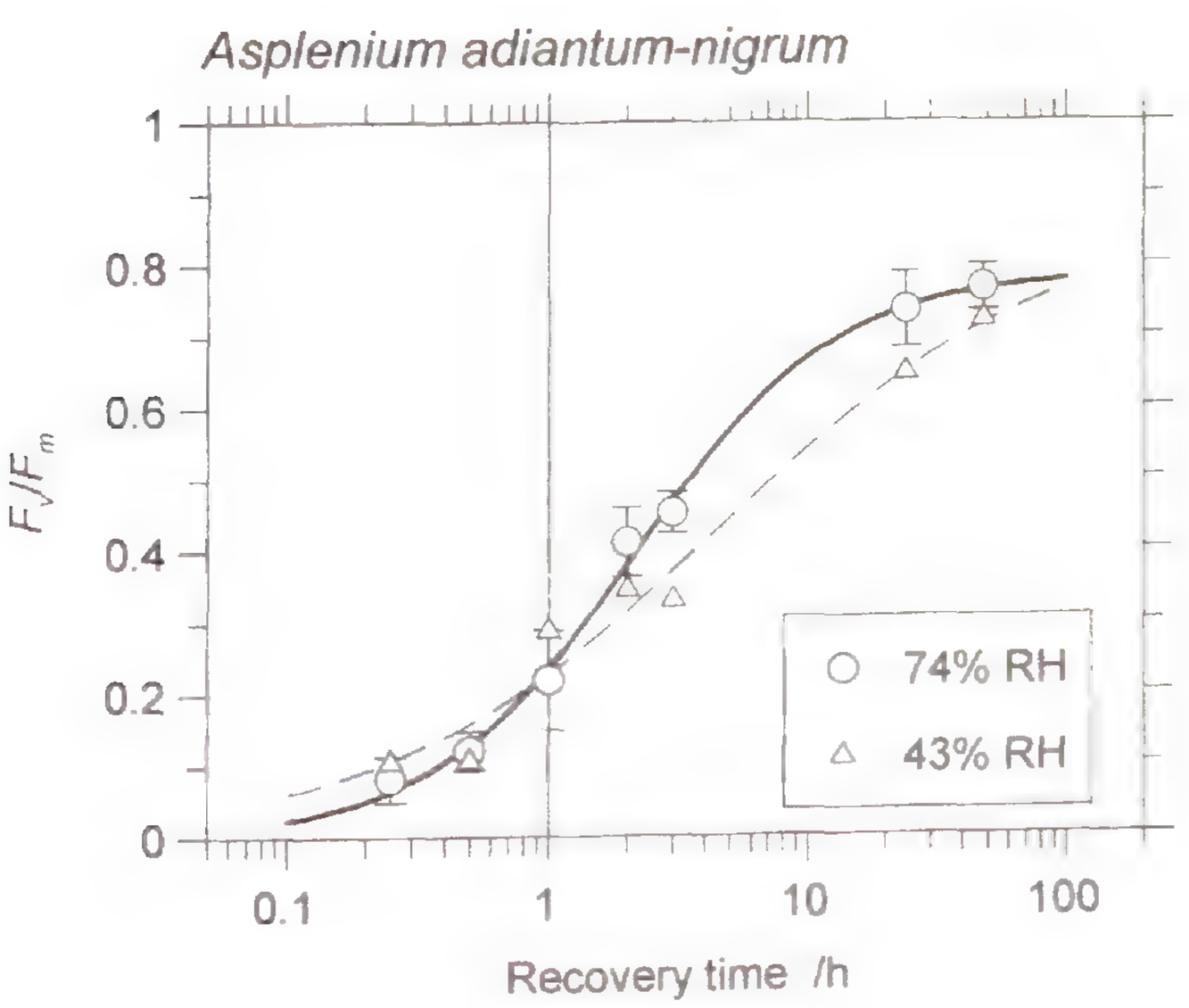

Figure 3. Recovery of F_v/F_m on re-wetting leaves of *Asplenium adiantum-nigrum* after 6 days drying at 74% RH (–41 MPa; circles and full line) and 43% RH (–114 MPa; triangles and broken line; error bars omitted for clarity), with fitted 4-parameter logistic curves. Means ± s.d., $n = 6$.

probably the most tolerant, followed by *A. ruta-muraria* and *A. trichomanes*. In *A. adiantum-nigrum* it appears that some populations are tolerant, but others are not, or perhaps that tolerance varies with season, as Kappen found. *A. obovatum* seems (from one sample) to be less tolerant than *A. adiantum-nigrum*, and to show some differences between young and old leaves. Two leaves of *A. marinum* L. from near Kynance Cove, Cornwall in early June 2001 did not recover after drying, but this species should be tested from more sites. Kappen (1964) found the leaves of summer-green ferns such as *Dryopteris filix-mas* are similar to flowering plant leaves in their sensitivity to drying, with little variation through the season. Species which remained green through the winter were in general more tolerant in the winter and spring months, but the limiting leaf saturation-deficit given by Kappen for *Polystichum lobatum* (*aculeatum*) is little different from his corresponding figure for *Dryopteris filix-mas*. The experiment reported here gave no indication of desiccation tolerance in *P. aculeatum*. A high degree of desiccation tolerance is seen in *Polypodium cambricum* and *P. interjectum*; the '*Polypodium vulgare*' that Kappen found the most desiccation tolerant of all his ferns was probably *P. vulgare* L. sensu stricto.

The A*splenium* species dried quickly, with a half-drying time of a few hours, and there is clearly little stomatal control over water loss; six leaves of *A. ceterach* gave half-drying times ranging from 2.5 to 9.0 h (depending on size), with a mean of 4.8 ± 2.3 h. Drying of *Polystichum aculeatum* was only a little slower. The *Polypodium* species dried much more slowly, with half-drying times in *P. interjectum* of a day or two, suggesting that the stomata close under water stress. This may be related to the habitats of the plants. The *Asplenium* species primarily occupy open, brightly lit and often sunny rock-crevice habitats. In bright sunshine in summer, a small *Asplenium* is sitting immovably in the steep temperature gradient close to the ground surface. In this situation a turgid, actively metabolising plant needs the cooling effect of transpiration to keep its leaves from reaching lethal temperatures (*c.*45–50°C), and leaves of these small ferns are correspondingly dependent on a constant supply of water from the root system to maintain turgor. Once air dry, desiccation-tolerant plants can withstand much higher temperatures. Plants tall and open enough for the air to circulate freely around their leaves do not face this overheating hazard, and *Polypodium* leaves, held free of the substratum on flexible petioles would be expected to be more closely coupled to the temperature of the air. Perhaps *Asplenium ceterach*, with its dry leaves curved away from the substratum and protected by their thick scaly covering, comes somewhere between *A. ruta-muraria* and *Polypodium cambricum* in this respect. In their photosynthetic responses, the small *Asplenium* species have something in common the desiccation-tolerant mosses in the same habitats. In this they differ from *A. ceterach* and *P. cambricum*, but these latter two are still not, photosynthetically, unequivocal sun plants.

The ferns rooted in rock crevices can probably all draw on substantial reserves of water at depth, which dry up only in hot dry spells in summer. *Polypodium* is probably drawing mainly on a more superficial reserve of water, which both dries up and is replenished more frequently, and this must underlie its success as an epiphyte (Zotz & Hietz, 2001). Recovery took place at similar rates in all the ferns examined, with half-recovery times around 2–4 hours, in contrast to the wide range of recovery rates in bryophytes (Table 3).

These desiccation-tolerant ferns are interesting in an ecological and evolutionary context. Proctor & Tuba (2002) postulated two strategies for plant life on land,

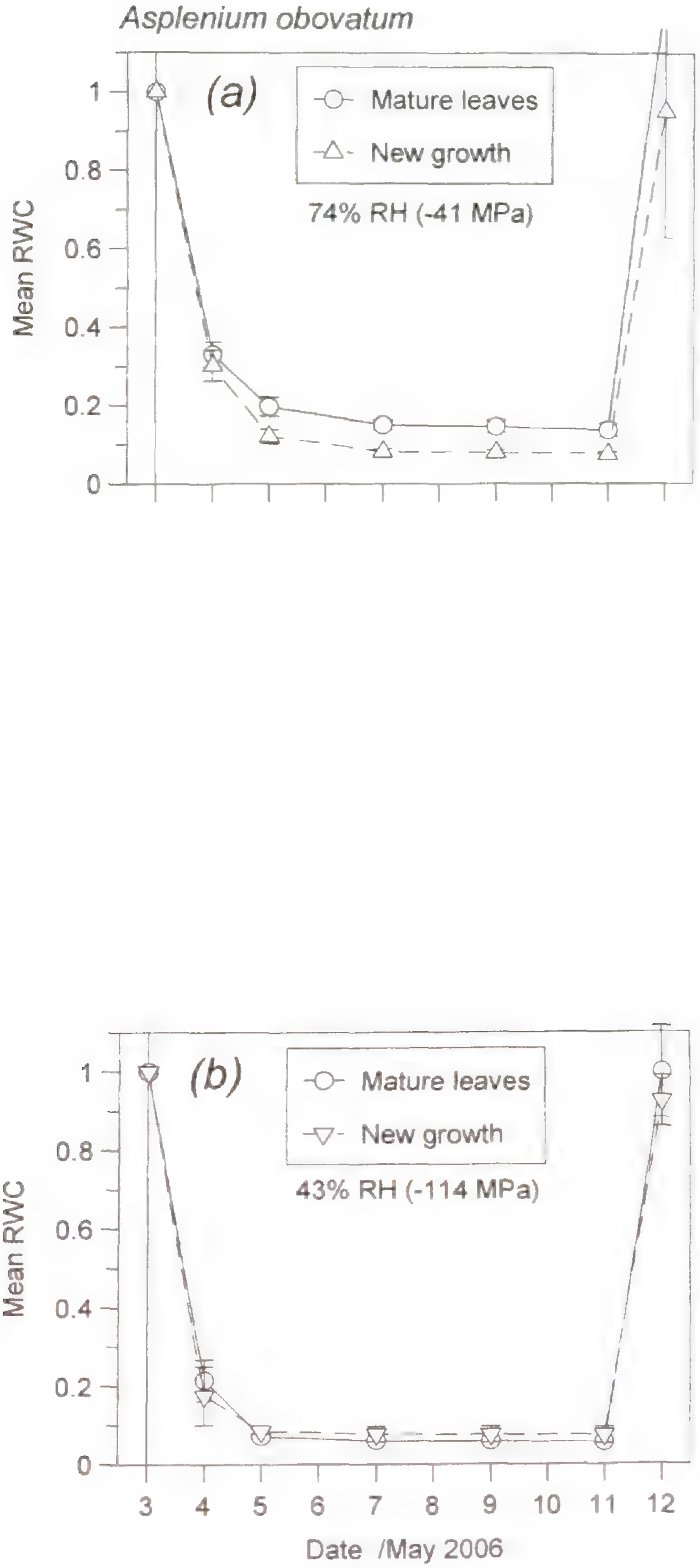

Figure 4. The course of RWC during drying and re-wetting with (a) desiccation at 74% RH (–41 MPa) and (b) at 43% RH (–114 MPa). Note in (a) the lower final RWC and less complete recovery of new leaves, and lack of significant difference between old and new growth in (b); half-drying times in (a) are about 11 h, and in (b) abour 9 h.

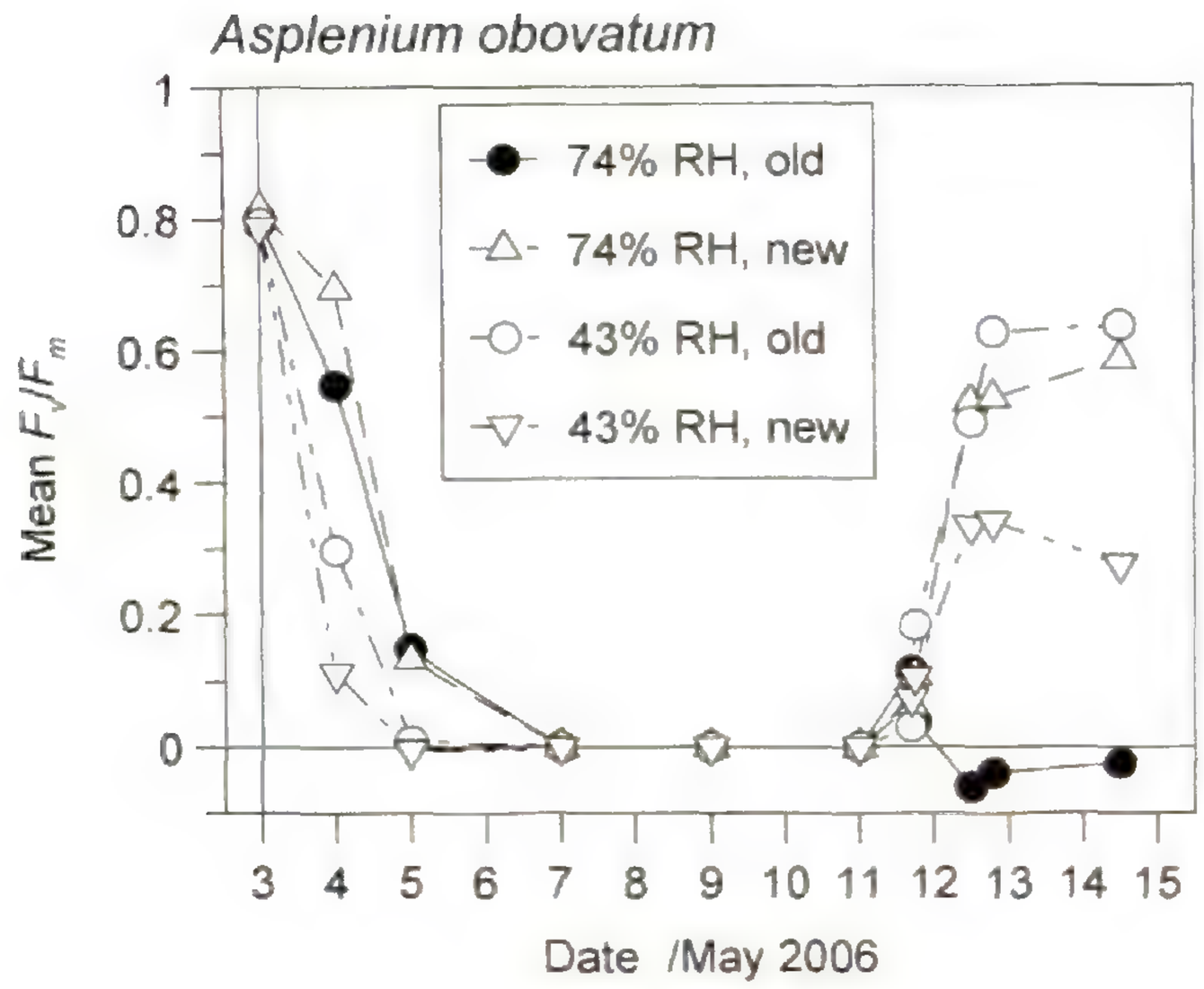

Figure 5. The course of F_v/F_m over the duration of the experiment. Note more rapid decline in F_v/F_m in the new growth, parallelling its faster drying, and the varied recovery of old and new growth following the two desiccation treatments.

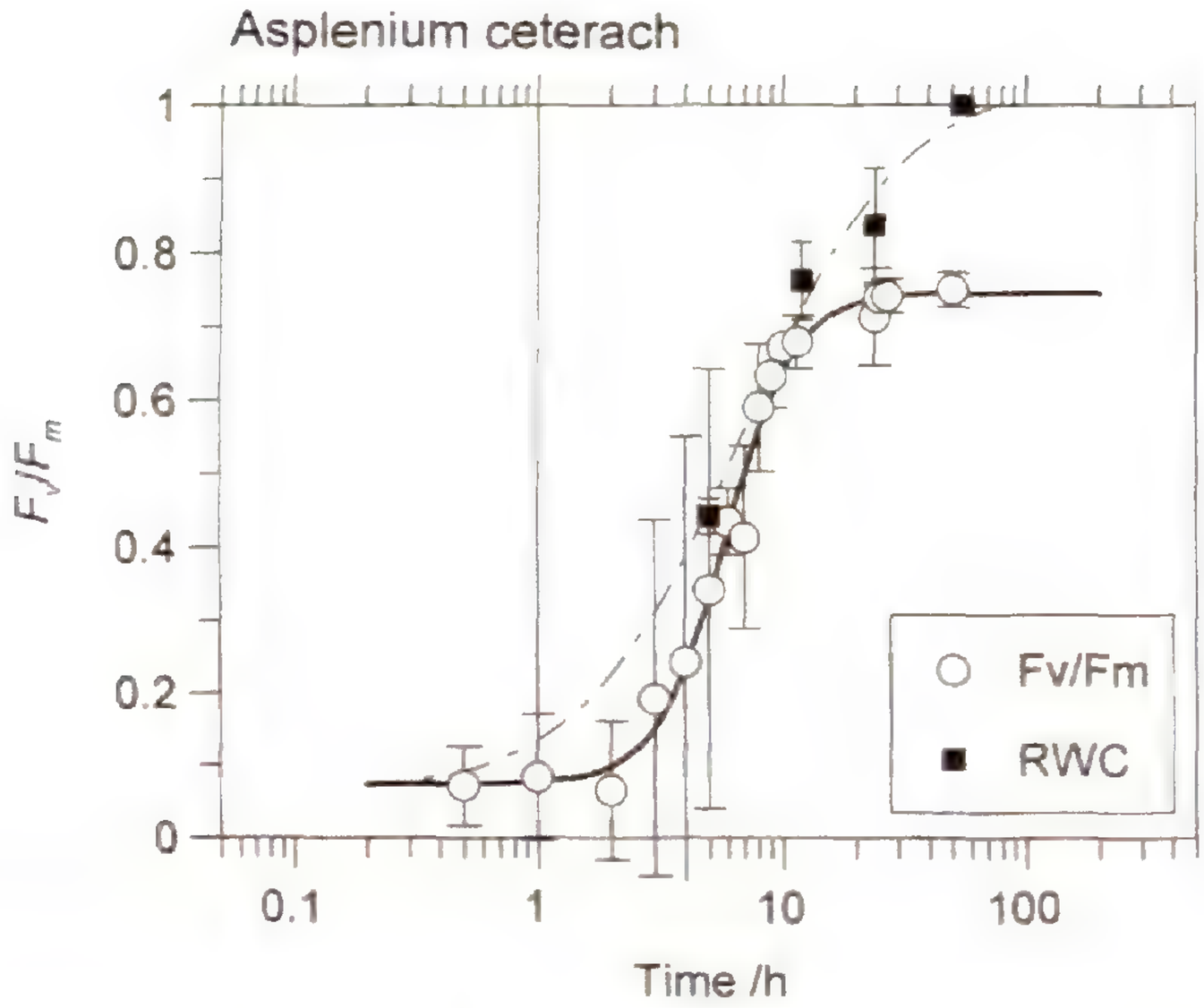

Figure 6. Recovery of F_v/F_m and RWC (from different samples) in *Asplenium ceterach*. (data set (2) of Table 3) Mean ± s.d., $n = 2$ (F_v/F_m), $n = 3$ (RWC). Fitted 4-parameter logistic curves. Note the very wide error bars in the lower part of the curve, reflecting the variation between replicates in the 'latent' time before recovery of F_v/F_m begins.

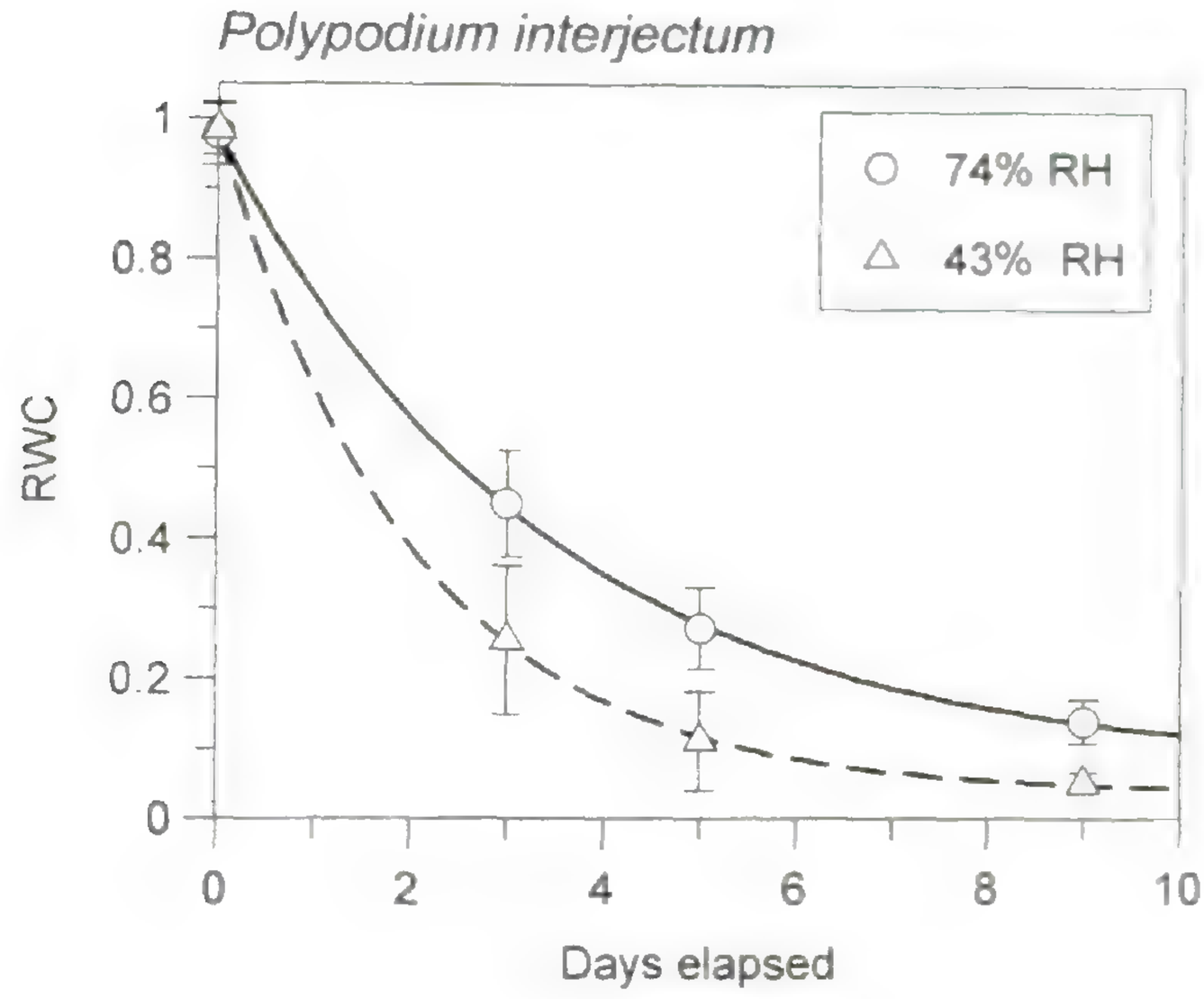

Figure 7. Drying data for RWC in *Polypodium interjectum* at 74 and 43% RH (-41 and –114 MPa), with fitted exponential curves.

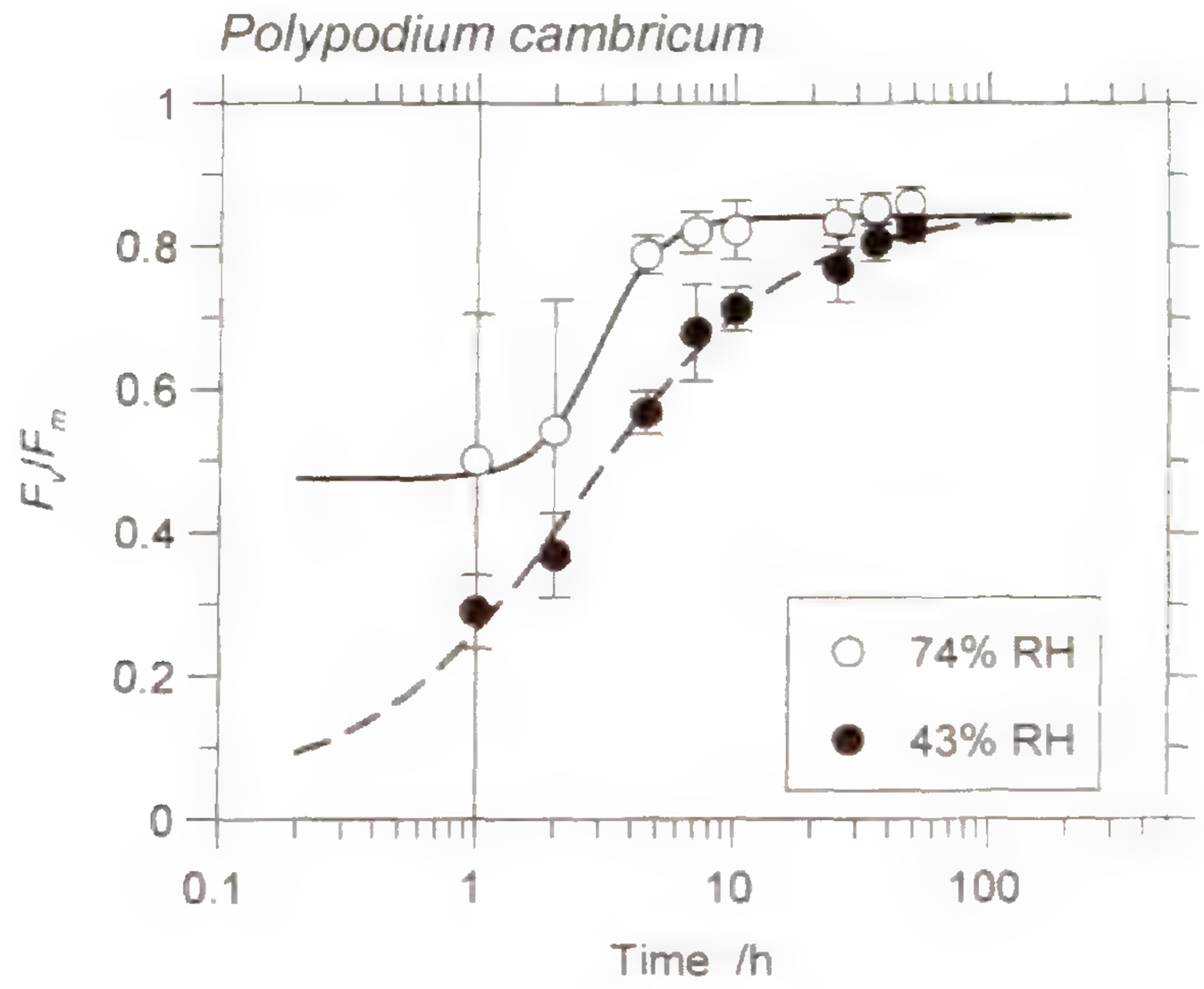

Figure 8. Recovery of F_v/F_m following re-wetting of *Polypodium cambricum* after 8 days' drying at 74% and 43% RH (-41 and –114 MPa). The only significant difference in the parameters of the fitted curves is in their lower limit.

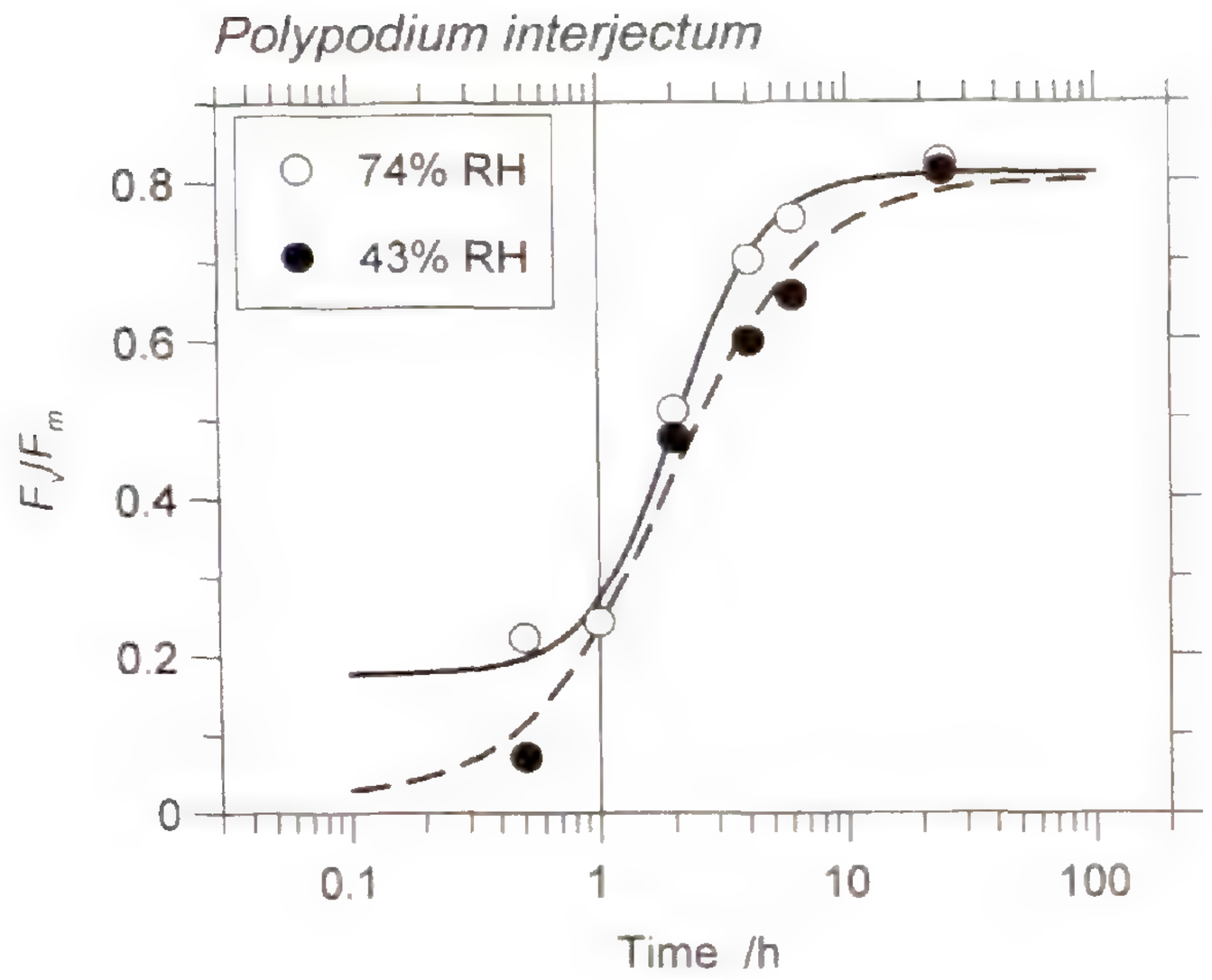

Figure 9. Recovery of F_v/F_m following re-wetting of *Polypodium interjectum* after 8 days' drying at 74% and 43% RH (41 and 114 MPa). As in *P. cambricum*, the only significant difference between the fitted curves is in their lower limit.

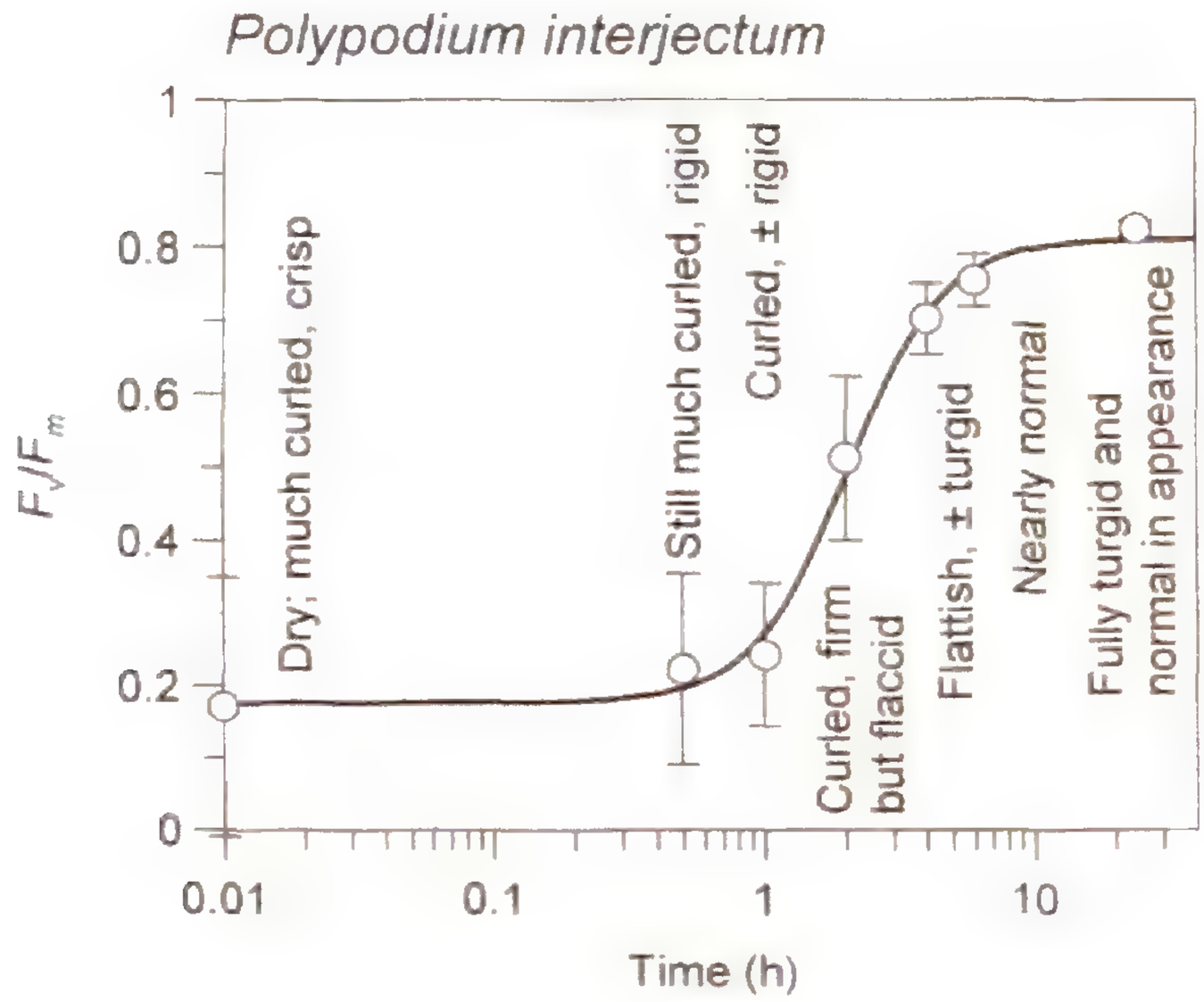

Figure 10. The 74% RH recovery curve of Figure 10 annotated with the appearance of the leaves at intervals during re-wetting; the comments relate to the successive data points. The mean value of F_v/F_m in dry leaves is arbitrarily plotted at 0.01 h.

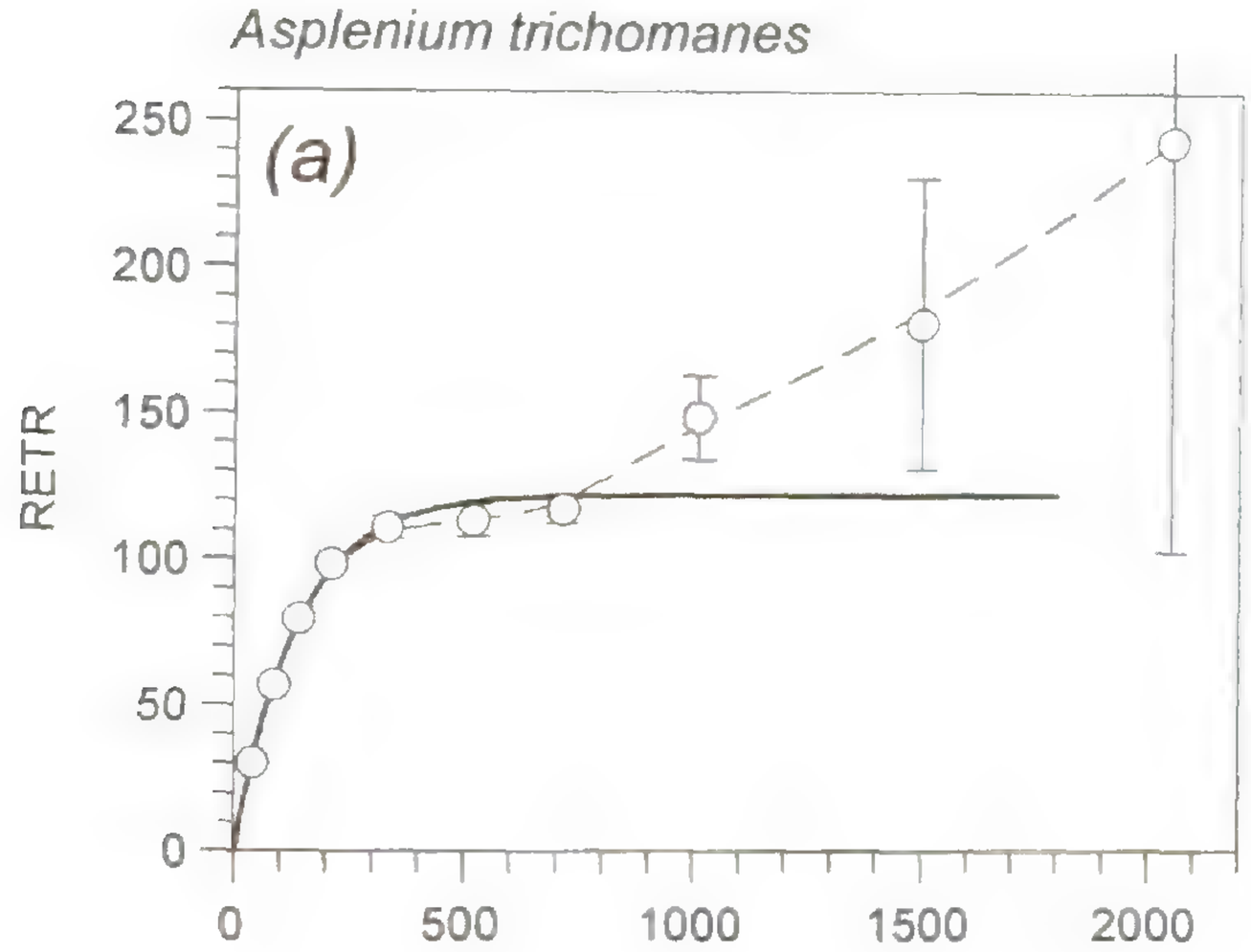

Figure 11. Light response of photosynthetic electron flow in (a) *Asplenium trichomanes*, showing (very variable) non-saturating electron flow at high irradiance, and (b) *Polypodium cambricum*, showing (consistent) depression of electron flow at high irradiance.

Table 3. Parameters of logistic curves fitted to F_v/F_m recovery data; fitted values ± standard errors. Upper and lower asymptotes are given for 4-parameter curves; logistic curves starting from zero have only an upper asymptote, estimating fully-recovered F_v/F_m. The figures for *A. ceterach* are from Spring 2008 data.

Species	Half-recovery (IC-50) /h	Rate (slope) parameter	Upper and lower asymptotes	
			Upper limit	Lower limit
Asplenium ruta-muraria	3.05 ± 0.48	-1.34 ± 0.28	0.79 ± 0.10	0.04 ± 0.06
A. trichomanes (1)	1.73 ± 0.27	-0.86 ± 0.11	0.88 ± 0.04	-
A. trichomanes (2)	3.90 ± 0.22	-0.81 ± 0.03	0.87 ± 0.0.02	-
A. septentrionale	1.64 ± 0.08	-1.11 ± 0.06	0.75 ± 0.02	0.25 ± 0.01
A. adiantum-nigrum (2) [-41 MPa]	2.11 ± 0.20	-1.12 ± 0.11	0.79 ± 0.02	-
A. adiantum-nigrum (2) [-114 MPa]	4.46 ± 3.42	-0.68 ± 0.20	0.86 ± 0.17	-
A. ceterach (1)	3.59 ± 0.27	-1.97 ± 0.27	0.94 ± 0.16	0.04 ± 0.02
A. ceterach (2)	5.80 ± 0.33	-3.07 ± 0.44	0.75 ± 0.05	0.08 ± 0.02
Polypodium cambricum (-41 MPa)	2.92 ± 0.20	-3.68 ± 0.55	0.84 ± 0.02	0.48 ± 0.01
Polypodium cambricum (-114 MPa)	2.45 ± 0.27	-1.09 ± 0.13	0.85 ± 0.05	0.04 ± 0.03
P. interjectum (-41 MPa)	2.03 ± 0.18	-2.43 ± 0.43	0.81 ± 0.05	0.18 ± 0.02
P. interjectum (-114 MPa)	1.87 ± 0.43	-1.51 ± 0.50	0.80 ± 0.11	0.02 ± 0.05

Table 4. Light-response parameters of some desiccation tolerant ferns. The 95% saturation values (mean ± SD) are calculated from negative-exponential curves fitted to the data-points for irradiances below 400 *m*mol m-2 s-1; all the species give a good fit to this part of the curve. At higher irradiances, *Asplenium ruta-muraria*, *A. trichomanes* and *A. septentrionale* all show the non-saturating electron flow commonly observed in desiccation-tolerant bryophytes (Marschall & Proctor, 2004). Most of the other species show at least some depression of photosynthetic electron flow at high irradiance, so that *Asplenium ceterach* and *Polypodium cambricum* may in practice seldom reach the '95% saturation' values given above. All species show high NPQ values by typical vascular-plant standards. Parameters have been given for *1-qP* only when the logistic curves gave a sufficiently satisfactory fit to the data; the fit of the curves is very sensitive to error in the highest few data points.

Species and comments	$PPFD_{95\%}$ /i mol m^{-2} s^{-1}	NPQ		1 - qp	
		y-range	IC-50	y-range	IC-50
Asplenium ruta-muraria, Chudleigh, Dec 2000	821 ± 40	10.68	511	0.87	1543
Asplenium ruta-muraria, Chudleigh, Jan 2001	772 ± 192	10.91	1077	-	[>1000]
Asplenium septentrionale, Trefriw, Sep 2004	566 ± 82	7.91	1813	-	-
Asplenium trichomanes, Chudleigh, Dec 2000	405 ± 41	7.91	487	0.74	299
Asplenium adiantum-nigrum, Budleigh Salterton, Jan 2001	524 ± 301	5.56	368	1.21	1201
Asplenium obovatum, Gammon Head, (last season's growth)	421 ± 81	4.99	295	0.94	573
Asplenium obovatum, Gammon Head (new-season's leaves)	550 ± 91	6.12	440	-	[>500]
Asplenium ceterach, Chudleigh, Jan 2001 (last season's growth)	1142 ± 104	7.85	772	-	[>1000]
Asplenium ceterach, Chudleigh, Jan 2001 (new-season's leaves)	834 ± 84	8.33	644	-	[>1000]
Polypodium cambricum, Chudleigh, Jan 2001	772 ± 215	5.43	400	1.02	839

exemplified by the homoiohydric mainstream vascular plants on the one hand, and the poikilohydric, desiccation-tolerant bryophytes on the other. Alongside the contrast between homoiohydry and poikilohydry there is another contrast, between *endohydry* and *ectohydry*. In vascular plants the physiologically important free water is in the xylem; they are *endohydric*, and the plant body is isolated from its surroundings by a waterproof and water-repellent epidermis. In most bryophytes, the physiologically important water is in capillary spaces outside the plant; they are *ectohydric*. The desiccation tolerant fern sporophytes considered in this paper withstand drying (and are to that extent poikilohydric), but are endohydric. This is also true of most other vascular 'resurrection plants'. All of these plants function as normal vascular plants when water is freely available, but they have added to their repertoire of responses the fall-back option of desiccation tolerance (already inherent in their spores) when the water supply fails. We are in a region of ecological niche-space where several adaptive strategies converge, and none is optimal. Desiccation-tolerant ferns share their habitat with fully poikilohydric (and ectohydric) mosses and liverworts, with small succulents, and (seasonally) with winter annuals. Fern gametophytes, on the other hand are unequivocally poikilohydric and ectohydric, and take their place alongside bryophytes in a diversity of habitats where some of them are as desiccation tolerant as their bryophyte neighbours (Watkins *et al.*, 2007).

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